# ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

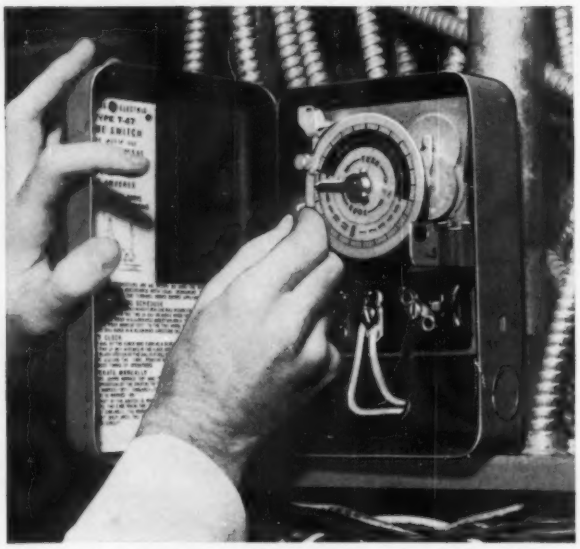
S. R. Todd, Chicago, becomes new president of International Association of Electrical Inspectors

Skylight without daylight in Whitney Museum, New York, employs carefully matched fluorescent sources to provide true color

Functional, full-capacity residential electrical systems design — a special editorial report — begins on page 69

A McGRAW-HILL PUBLICATION

**MODERATE PRICE:** For only $11.50* G.E.'s T-47 Time Switch provides reliable on-off control for many electrical operations; eliminates manual push-button "start-and-stops."



**ACCURATE ON-OFF SETTING:** Minimum on-time setting, 5 min.; maximum on-time setting, 22 hrs. for 1 or 2 on-off operations daily. Only the T-47 offers such close time setting.

# Low-Cost, Dependable On-Off Control With General Electric Time Switches


**PRECISION TIMEKEEPING:** Once set, a long life of dependable control on a predetermined schedule is assured in this time switch by the synchronous, self-starting, Telechron† motor.

In addition to offering inexpensive, positive on-off control, the General Electric T-47 time switch has two additional advantages:

**FAST INSTALLATION**—Easily removable snap-cover, plainly marked terminals at switch front, roomy hand space and five double knockouts facilitate installation.

**IMMEDIATE EXCHANGE PLAN**—If the T-47 becomes inoperative within 18 months after date of manufacture, you receive *immediate,* over-the-counter replacement at no extra charge.

**FOR MORE INFORMATION** on T-47, contact your nearest authorized General Electric time switch distributor. Ask for G-E time switches at his store by name and write for Bulletins GEA-5965 and GEC-578B to Section 603-169, General Electric Company, Schenectady 5, New York.

*Mfr's suggested retail price.
†Reg. Trademark of General Electric Co.

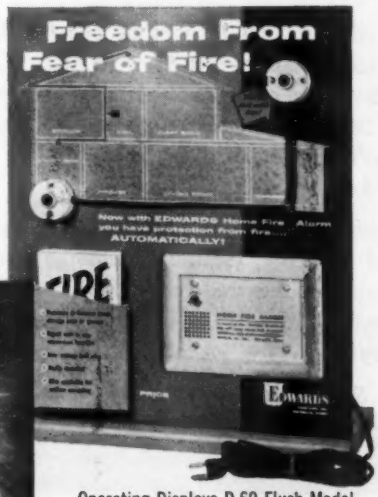
GENERAL ELECTRIC

## Light a match, start a sale!

# OFFER FREEDOM FROM FEAR OF FIRE

**for only $19.95**

F-200 Complete surface signal unit and 2 detectors, $19.95. Flush model for new home builders, F-100. $19.95. **Your** profit—$7.98. (Additional detectors, $3.50)




Operating Displays D-60 Flush Model above, or D-61 Surface Model, $22.95

It's a low priced, high ($7.98) profit, high volume item! It offers something everyone needs and wants—freedom from fear of fire. It's the Edwards Home Fire Alarm. Easy to demonstrate . . . easy to sell! Just hold a match under detector on Edward's dramatic demo-display—or let your prospects do it! They'll hear the loud clear life-saver bell! Explain that detectors give 400 sq. ft. safe coverage each, set off alarm at 140°. Explain that system is foolproof, automatic, electric, permanent. Never needs servicing or adjustment. Uses current only when sounding alarm. Uses low cost easily installed bell wire. Tell them that in most fires it's the first five minutes that count—**that the Edwards home fire warning system can save their homes, their family's lives!** Here's a sure-fire seller. Order from your wholesaler or write for details, Department **ECM-3**, Edwards Company, Norwalk, Conn. In Canada, Owens Sound.

## EDWARDS HOME FIRE ALARM

**"Permit me to congratulate you on the production of a fine light..."**

**Charles A. Comiskey**


# APPLETON

**INTENSO**
TRADE MARK

## *Alzac Aluminum Floodlights*

**FOR ATHLETIC FIELDS and OTHER LARGE AREAS**

**Split-Second Rear Relamping**—No tools needed! No nuts or bolts! Rear lid with lamp opens wide for easy access! Do it in seconds even during a game!

**Rifle Like Aiming**—After servicing, just flip lid down and clamp! Unit now weather sealed, perfectly! Exclusive louver ventilation eliminates condensation! Aim merely by looking through peep sight, then locking in position!

**New APPLETON Lights at Famed Comiskey Park in Chicago Turn Night into Day!** 768 *Intenso* floodlights mounted on eight towers give daylight visibility to the entire field. No wonder Charles A. Comiskey says "...the new White Sox lighting is unequalled anywhere in the Major Leagues..."

In addition, APPLETON *INTENSO* Floodlights offer greater ease of servicing, cleaning, relamping and positioning for maximum trouble-free year 'round lighting. That's why we say, investigate APPLETON *INTENSO* Floodlights before you buy!

*Sold Exclusively Through Selected Wholesalers*

**APPLETON ELECTRIC COMPANY**
1704 Wellington Avenue • Chicago 13, Illinois

APPLETON ELECTRIC PRODUCTS — REG. U.S. PAT. OFF.

*Also Manufacturers of:*


*Rely on* **APPLETON** *...The Standard for Better Lighting*

# ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The Electragist and Electrical Record — Established 1901

Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

*54th Year* **MARCH • 1955**




MORE

## MARCH • 1955 *continued*



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# Sidelights

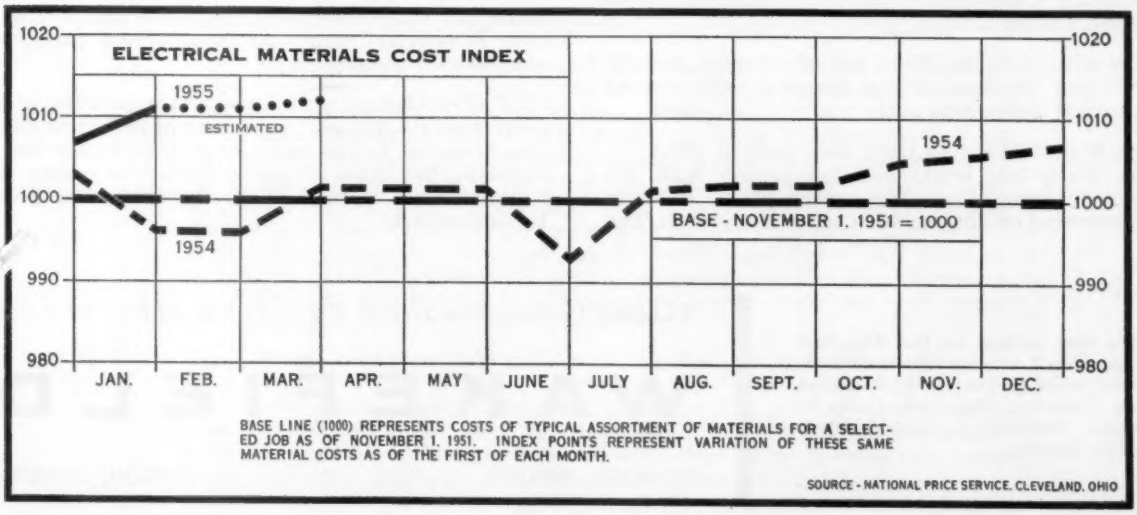
**EXPLOSION-PROOF LIGHTS** – Seldom are production areas containing explosive vapors well lighted. Such areas require approved type explosion-proof units, and the types previously available for incandescent lamps have been costly and inefficient. Now Armour & Co. has used a new explosion-proof fluorescent lamp luminaire with higher efficiency to light their new Pharmaceutical Center plant in Kankakee, Ill. The installation is described in the story beginning on page 96.

**THE SKY'S THE LIMIT**–As aeronautical science extends our horizons of speed and altitude, increasing dependence is being placed upon the research laboratories of the NACA (National Advisory Committee for Aeronautics). These laboratories–where much vital knowledge is developed for both military and civilian aviation use –represent some of the greatest concentrations of power and finest electrical equipment ever assembled. The $100-million laboratory at Cleveland, for example, has a monthly consumption of 20-million-kwh, an incoming 132-kv power supply with a capacity of 400,000-kva, and an electrical distribution system second to none. This system–still in the expansion stage–is analyzed by NACA electrical engineers Kenneth Brumbaugh and Myron in the article "Power for Jet Research". This article–another in our series discussing Outstanding Electrical Installations–begins on page 84.

**EDUCATION ON THE MOVE**–Shifting centers of population in the Seattle area created a major educational problem until mobile classrooms were designed with pre-installed lighting, heating, signalling and electrical systems. Wiring of these add-a-unit structures was done by the Industrial Electrical Company, with special jigs, practical installation techniques and a wide assortment of power tools keeping costs down and quality up. Written by Industrial Editor Hugh P. Scott during a recent west-coast field trip, the article on "Wiring Portable Classrooms" is to be found on page 93.

**MAXIMUM LOAD CAPACITY**–Power consumption continues to skyrocket, but load growth is due largely to such low power-factor items as fluorescent lighting, air conditioning and induction motors. This places increased importance upon the proper installation of equipment, for this can result in obtaining greater capacities from power lines, and can greatly boost returns on system investments. Optimum conditions result only when loads are properly balanced, neutral current is negligible and the power factor approaches unity. How this is accomplished is the subject of "3-Phase Loads Unbalanced", authored by A. L. Nylander of General Electric. You will find his discussion on page 102.

**HIGH VOLTAGE TREND**–High tension distribution has long been recognized as the best means of spreading electric power among widely separated centers of load utilization. Until recent years, however, use of high voltage has been limited due to complexity of installation and consequent high cost. But an increasing trend toward high voltage distribution is now evident–a result of greatly improved equipment which provides the necessary insulation and protection in a simple layout. A case in point of the simplicity of such distribution today is the Calliope Street Housing Project, New Orleans, La. In a story on page 76, Dan Duvoisin, president of Atlas Electric, New Orleans, electrical contractors who made the installation, describes some of the details of the 13.2 kv system serving 48 buildings. Close-up sketches pinpoint pothead methods, underground work, service to buildings and walkway lighting.




BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.

SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO

**PRIVATE OFFICE:** Campbell-Mithun Agency, Northwestern Bank Building, Minneapolis, Minn.

**AGENT:** North Central Electrical Distributors

1st PRIZE
SCHOOLS AND OFFICES CLASSIFICATION
*Lighting Competition Sponsored by*
ELECTRICAL CONSTRUCTION & MAINTENANCE

NOTE: 1st, 2nd and 3rd prizes in this classification were all won with Wakefield equipment.

# WAKEFIELD SIGMA IN A PRIVATE OFFICE

## by *JOHN KVOLSTEN ELECTRIC COMPANY*

"The color scheme in this office is a natural colored burlap wall with blue draperies and a cream ceiling. Furniture is in walnut with varied colors of upholstering. Carpet is beige.

"For a beam ceiling effect, one of the most recently developed luminous ceiling elements with vertical acoustical baffles was used.

"Six Wakefield Sigma units were used to provide a high level, low brightness illumination with the beamed ceiling effect. The arched plastic diffusers are mounted on hinges with a touch latch catch. The maintenance features are particularly desirable.

"Twelve 96" T12, 430 MA de luxe and de luxe cool lamps (six each) were used behind the panels. Each color is switched separately to provide a variation of color environment.

"80 footcandles are maintained on the desk top with an average maintained in the room of 70 footcandles. The luminous ceiling has a brightness of 220 footlamberts, the baffle 50 footlamberts, the ceiling 10 footlamberts, the wall 25 footlamberts, the floor 15 footlamberts."

For a new catalog on the Wakefield Sigma, as well as other Wakefield Geometrics, write to The F. W. Wakefield Brass Company, Vermilion, Ohio. In Canada: Wakefield Lighting Limited, London, Ontario.

*Wakefield Congratulates JOHN KVOLSTEN ELECTRIC CO.*

**WAKEFIELD**

VERMILION, OHIO LONDON, ONTARIO

# Washington Report

**Business optimism grows** as economic improvement continues. Examples: Steel production is at rate of nearly 90% of capacity, expected to hit 95% in April—up from less than 70% year ago; auto production in January hit an all-time high for that month at over 600,000, up from 456,000 in January year ago, while high production rate continues; new building construction, including housing, continues its steady growth—now at record annual rate of $40 billion; personal income end of 1954 was at highest rate ever—$291 billion annually; and there are many more just as spectacular.

**Electric power output** topped 10 billion kwhr per week to set a new record during last week of January, for a rate of gain over a year earlier of 13%. Greatest increase was 28.6% for the Southeast. Addition of some 13 million kw capacity during 1955 will raise the total to 115 milliom kw, or more than double the 52.3 million kw capacity of 1947.

**Tax relief** for corporations and individuals will probably be put off another year. Eisenhower has asked for extension of 52% corporate tax rate, and of excise tax rates. With the new federal budget still showing an estimated $2.4 billion deficit, tax cuts for individuals are also being dropped.

**Strikes in 1954** totaled 3,450 and resulted in loss of 22 million man-days for some 1.5 million workers, BLS reports. While still a serious loss for the economy, it is the lowest total for annual strike losses in ten years, and is less than one-fifth the record high of 116 million man-days lost in 1946.

**January construction outlays** were greater than for any January on record, at $2.8 billion for public and private spending—13% above January 1954 total. This topped a $40-billion annual rate, as compared with 1954's actual $37.2-billion outlay, Labor and Commerce Depts. reported. Private construction, at $2 billion, set a record for the month—20% over the year-earlier level. Half of the private fund total was for new home building, but large increases in religious, educational, and commercial building were also made. New home building was up a third, religious up 29%, educational up 23%, and commercial up about 15%, all as compared with January of last year.

**GOP-sponsored construction programs** before Congress are sizable, and final action on them will be worth watching. They include Eisenhower's $101-billion 10-year road building program, $7-billion school construction program, and loan guarantee program for more hospital construction.

**Housing starts for January** were 88,000 or 33% more than the year-earlier total of 66,400, BLS reported. Private home starts were 87,800, public housing starts 200. Total starts are being made about twice as fast as families are being formed, has raised some doubt on how long the current boom will last. Population rise and easy credit, plus other possible forces, are credited with supporting the boom. But Housing Administrator Albert M. Cole, after study of the question with housing officials, says housing credit appears sound and he has no plans to put on the brakes. Democratic Congressmen, meanwhile, are pushing for federal aid for 70,000 low-cost public housing units a year (vs Eisenhower's request for 35,000 units), even though biulders report trend is to higher-cost homes, and "for rent" signs are increasing.

**Home mortgage debt** of Americans for one-to-four-family homes has passed the $75 billion mark, up 14% during 1954, and up 285% since 1945. This indebtedness held steady at below $20 billion for 15 years, between 1930 and 1945. Over 40% of today's home mortgages are underwritten by the Federal Government, and more than 40% of these new home owners have less equity in their residences than ever before.

# This New Exclusive Republic Feature


**ARROWS ON THE NEW REPUBLIC BENDER** line up with new Guide Line on Republic "Inch-Marked" E.M.T. With tubing and "Inch-Marks" lined up, electricians can easily make a smooth, accurate bend.

**WHEN YOU GET A "WOW"**, here's what happens. Bend is smooth, but out of line. With the new Guide Line, bends can be pre-planned, made accurately, right on the job.

**REPULIC STEEL CORPORATION**
**Steel and Tubes Division**
**212 East 131st Street**
**Cleveland 8, Ohio**

REPUBLIC STEEL

Please send me more information on Republic ELECTRU-NITE E.M.T.

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Company_____

Address_____

City_____ Zone____ State_____

K-8086


# brings you more savings on E.M.T. installations

## The "Guide Line" that eliminates "wows". Now on all popular sizes of Republic "Inch-Marked" E.M.T.

The new line down that tube means your electricians can *plan* the most accurate bends you've ever seen *before* they make them. It means no more out-of-line bends. And the new Republic Bender has built-in marks to line up the tubing so that journeymen just can't miss.

Add this new feature to "Inch-Marks", easy bending, easy wire-pulling because of inside-knurling, no lines to turn, and you can see how you can save on installation when you use Republic "Inch-Marked" E.M.T. Use it on your next job. And when you ask your distributor for it, don't just say "E.M.T." Ask for *Republic "Inch-Marked®" E.M.T.* The E.M.T. with the new *Guide Line.*

**REPUBLIC STEEL**

*World's Widest Range of Standard Steels and Steel Products*

# For Better Production, Performance and Profits...Specify Moloney

The superior engineering and fabrication inherent in Moloney Transformers offer you four points of foremost importance to your continuous production picture... efficient operation . . . location flexibility . . . low maintenance cost . . . quiet operation.

Moloney Transformers are designed *for the job* and built to *stay on the job,* to provide an uninterrupted flow of power under all operating conditions.

Gain better performance and greater reliability with less maintenance by specifying Moloney, the mark of quality for over 50 years.

ME54-28


Manufacturers of Power Transformers • Distribution Transformers • Step Voltage Regulators Regulating Transformers • Load Ratio Control Transformers • Unit Substations • Network Transformers • Constant Current Transformers • Capacitors • Transformers for Electronics

**MOLONEY ELECTRIC COMPANY**

**SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA**

# BENJAMIN

# "DIFFUSER"

## REFLECTOR UNITS

**...the Quality is UP, as well as the Light!**

### ...the Light is UP!

- 12% Upward Light for Greater Seeing Comfort*
- 85%-or-better Reflection Factor gives you MORE LIGHT!
- 83%-or-better Light Output Efficiency lets you take maximum advantage of efficient fluorescent light sources.

*for 2-lamp unit. 10% for 3-lamp unit.

### ...the Quality is UP!

- Top-quality "Life-Time" Porcelain Enamel Reflector!
- Delivers more light with easier maintenance!
- Rust-resisting channel finish.
- Available for 40-Watt Rapid Start or Preheat Lamps and in "Magna-Flo" construction for 96" and 48" Slimline Lamps.

New standards of industrial lighting call for UPWARD LIGHT to reduce brightness contrast, increase seeing comfort and minimize eye fatigue. You get this Upward Light with the Benjamin Diffuser-Reflector, without sacrificing the higher light levels on the *working surface* called for by today's industrial lighting standards.

Bulletin AD5929 brings you complete facts and lighting data on Benjamin's complete line of fluorescent equipment. Benjamin Electric Mfg. Co., **Dept. H,** Des Plaines, Illinois, makers of famous Benjamin and Leader Line Lighting Equipment and Sound Signals for Industry, Institutions, Commerce.

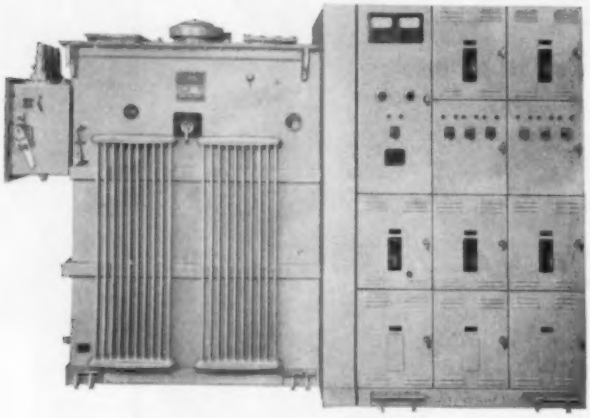
**Sold Exclusively through Electrical Distributors**

**NO OUT-OF-SERVICE TIME** Due to socket failure with depressible, exclusive, Benjamin, patented metal-clad, rust-resisting "Springlox" Lampholders. Contact is positive. Lamps are locked securely in place.

B-882

# SORGEL Substations are the best for Industrial, Commerical and Institutional Applications

**SORGEL transformers are particularly adaptable for indoor installations; in hospitals, libraries, schools, institutions, office buildings, and other structures where low noise levels are an important factor.**



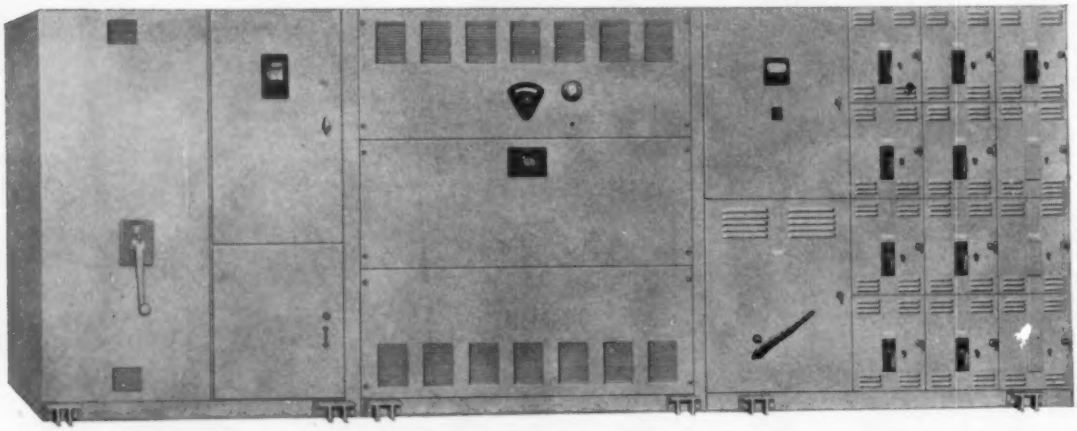
500 Kva, 13,800 volt Askarel-cooled SORGEL transformer, with primary liquid filled switch, secondary meters, and circuit breakers.

Because substations depend so much on transformers for continued, uninterrupted long service, SORGEL transformers are especially designed and constructed to meet the exact requirements of substation applications.

SORGEL transformers are not just ordinary transformers. They are especially designed and constructed to be installed indoors, close to load centers, thereby obtaining the most efficient distribution and better voltage regulation.

Without additional cost we make the substation fit the job, instead of expecting you to try to make the job fit the substation.

SORGEL transformers, 100 to 3000 Kva, all voltages up to 15 Kv, either dry-type or Askarel-cooled, to meet any requirements, can be furnished with any make or type of switchgear. And they are also procurable from any substation manufacturer.



2000 Kva 3-phase, 13,200 volts air-cooled dry-type transformer, with primary switchgear, metering, and secondary breakers.

*Sales Engineers in Principal Cities*

**SORGEL ELECTRIC CO., 836 West National Ave., Milwaukee 4, Wisconsin**

*40 years experience in the development, manufacturing and application of transformers*

# ROEPLASTIC CONTROL CABLE

*Since Roebling pioneered this unique type of cable three years ago sales and repeat orders have skyrocketed—sure proof of outstanding merit.*


No painted conductor tracers. Conductors are *one* dark color, each with its IPCEA code color *name* and its *number* distinctly printed from end to end with indelible plastic ink which forms an integral part of the insulation and cannot be erased.

## YOU WANT

*FREEDOM FROM ERRORS...*
*CONDUCTOR IDENTIFICATION*
*THAT IS SIMPLE AS A, B, C*
*YET ABSOLUTELY POSITIVE...*
*IN SHORT,*

## YOU WANT

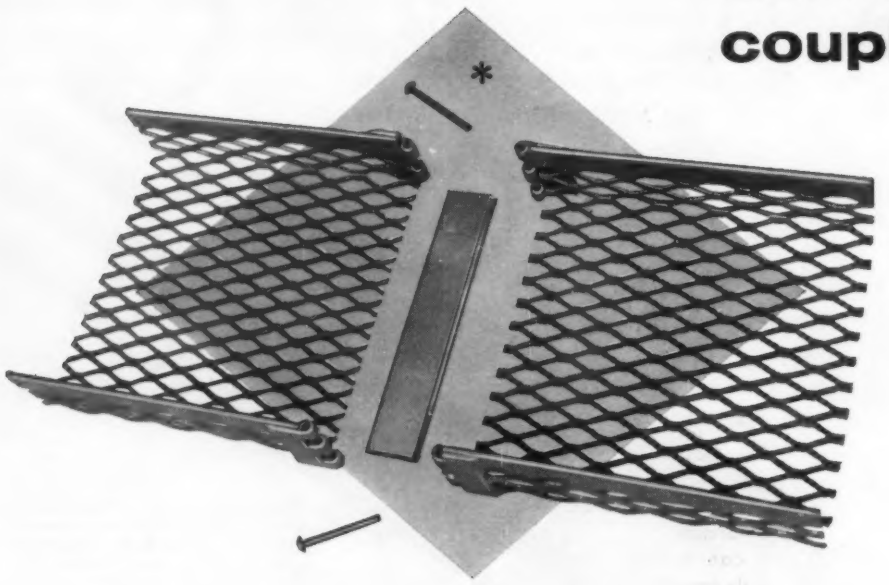
# ROEBLING

*Subsidiary of The Colorado Fuel and Iron Corporation*

JOHN A. ROEBLING'S SONS CORPORATION, TRENTON 2, N. J. BRANCHES: ATLANTA, 934 AVON AVE. • BOSTON, 51 SLEEPER ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 3253 FREDONIA AVE. • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. • ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, TRENTON 2, N. J.

ANOTHER EXAMPLE OF Cope EFFICIENCY...

# THE NEW 70,000 SERIES COPE CABLE TROUGH with the built-in coupler



## up to 80% savings in assembly time

The new 70,000 Series Cope Cable Trough with the built-in Pin-Type Coupler has been specifically designed to give a quick-coupling, stronger and more easily erected system for supporting power, control, and signal cables in industrial plants and generating stations.

The built-in Pin-Type Couplers make it possible for the trough and fittings to be assembled with up to 80% savings in field assembly time.

*PATENT PENDING

Cope Cable Trough is available in five standard widths, (6", 9", 12", 18", and 24") and lengths of 8', 10', and 12' with a wide range of fittings for each width which permits the trough to change direction and elevation to conform to any plant layout.

Find out more about the New 70,000 Series Cope Cable Trough. Write today for further information and the new 16-page Bulletin M-3.

*You know Cope by these products*

Cope

**T. J. COPE, INC.**

**711 SOUTH 50th ST., PHILADELPHIA 43, PA.**

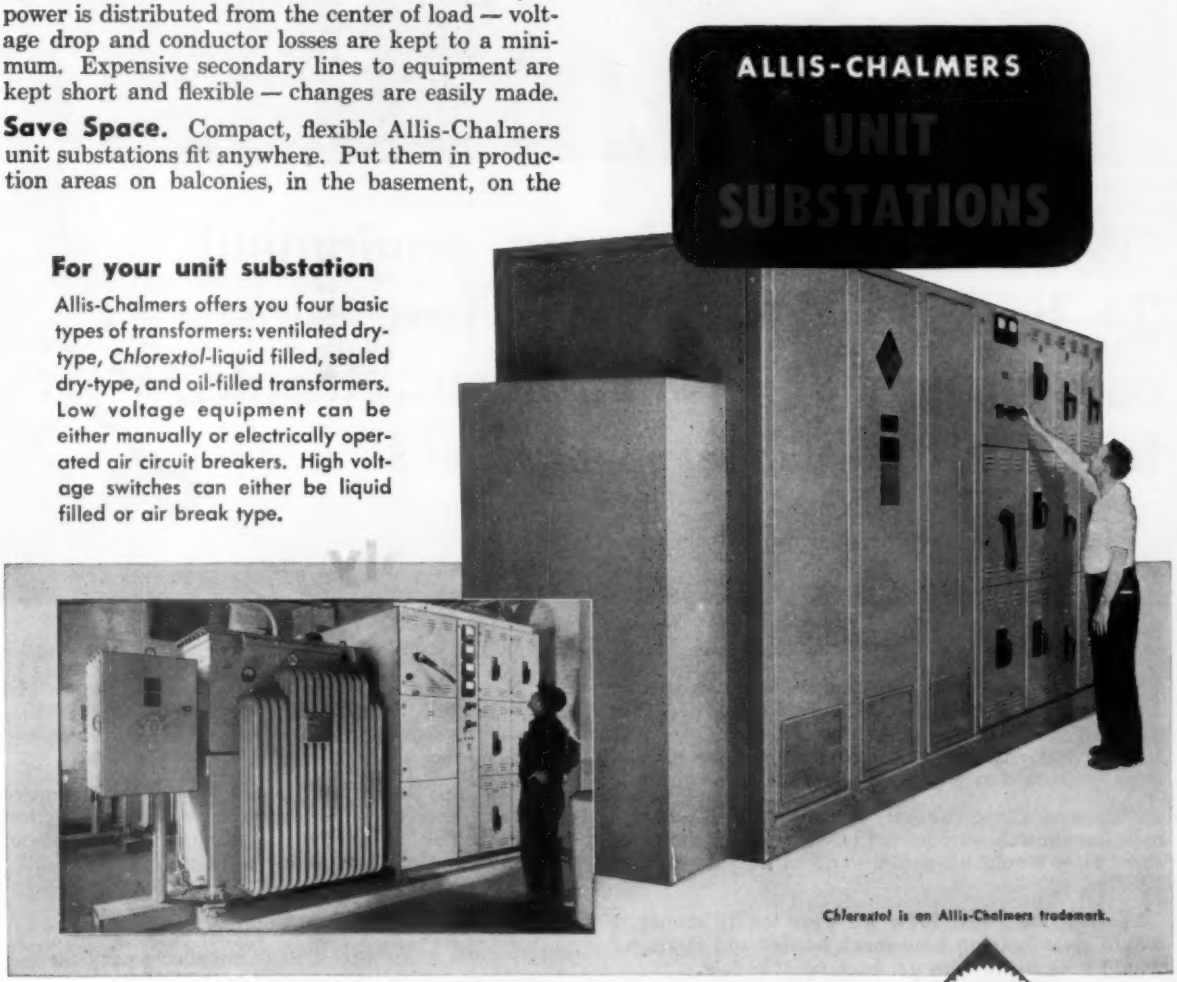
# Why You Should Modernize Electrically

VOLTAGE DROP COSTS YOU MONEY . . . in torque losses, lighting losses, and production losses. The cause is usually an outmoded or overloaded plant electrical system. Correcting low voltages is easy with Allis-Chalmers unit substations; and, in addition to eliminating these losses, you get new flexibility in plant arrangement that usually pays extra dividends.

**Get Your Full Value.** You save because *full* power is distributed from the center of load — voltage drop and conductor losses are kept to a minimum. Expensive secondary lines to equipment are kept short and flexible — changes are easily made.

**Save Space.** Compact, flexible Allis-Chalmers unit substations fit anywhere. Put them in production areas on balconies, in the basement, on the roof, or outside the building. Entirely metal-enclosed, they may be located with complete safety — no enclosures are required.

Let experienced Allis-Chalmers substation engineers help you solve distribution problems. Call your nearby Allis-Chalmers district office, or write Allis-Chalmers Mfg. Co., Milwaukee 1, Wisconsin, for your copy of "Power at Load Centers Pays Off" (11B6285B). A-4604

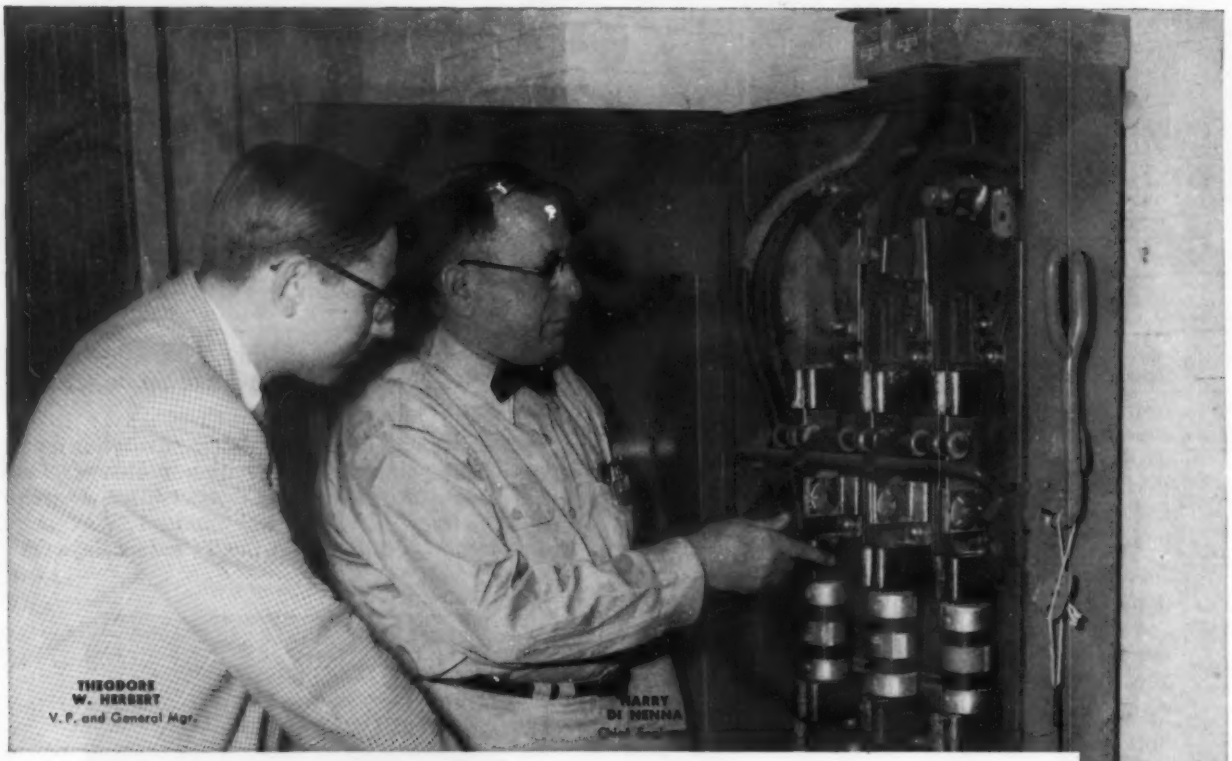



**For your unit substation**

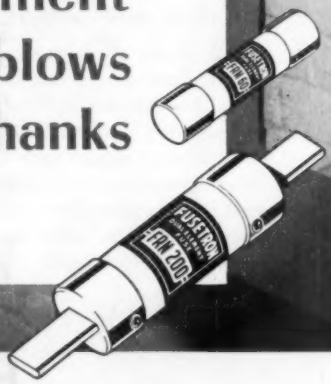
Allis-Chalmers offers you four basic types of transformers: ventilated dry-type, *Chlorextol*-liquid filled, sealed dry-type, and oil-filled transformers. Low voltage equipment can be either manually or electrically operated air circuit breakers. High voltage switches can either be liquid filled or air break type.

Chlorextol is an Allis-Chalmers trademark.

**ALLIS-CHALMERS**




# "We can now push our equipment 24 hours a day without fuse blows causing needless shutdowns, thanks to Fusetron *dual-element* Fuses."




"When we are on a tight schedule, we must operate 24 hours a day to fill our orders. Every piece of equipment in the plant is pushed to its limit. A work stoppage of any kind is more than annoying, it is most important as we just can't afford to waste time.

"We were using ordinary fuses to protect our motors, but these fuses couldn't hold up under the pressure. They would blow often and as I now know — needlessly.

"Every time a fuse blew we were losing money. I would start figuring how much harder and faster we would have to work to get back on schedule.

"Something had to be done. We called upon Mr. Paul Serotta of the Norristown Electric Supply Company. He recommended we discard our old fuses and replace them with Fusetron dual-element fuses.

"That was the answer all right. We can really notice the difference. Now, when we are on full production basis I am not worried that our equipment will be out of operation by the needless blowing of fuses."

*Harry DiNenna*
CHIEF ENGINEER
HERBERT HOSIERY COMPANY
NORRISTOWN, PA.

## *Play Safe!* install Fusetron and BUSS Hi-Cap

# Fusetron Fuses Do More Than Eliminate Shutdowns Caused By Needless Blows...

## FUSETRON FUSES PROVIDE 10 POINT PROTECTION...

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnouts.

## FUSETRON FUSES SAVE YOU Maintenance and Recalibration Costs

Once properly installed, Fusetron fuses require no costly inspection time or maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

When a Fusetron fuse does open to protect, and after the fault has been corrected — the new Fusetron fuse you have installed has been *calibrated at the factory by engineers* — it is a fuse as safe and dependable as the one that blew.

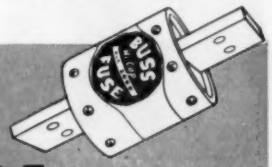
## FUSETRON FUSES GIVE YOU GREATER SAFETY, BECAUSE OF THEIR HIGH INTERRUPTING CAPACITY

Tests verified by the Electrical Testing Laboratories of New York indicate that Fusetron fuses can interrupt safely the most severe available short-circuit current.

The tests circuits were set to deliver in excess of 100,000 amps. In each test the fuse cleared the circuit safely, the fuse remained intact, there was very little noise and cotton packed around the fuse was not ignited.

Yet there has been no interference with the time-lag characteristic of Fusetron fuses.

## *FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS.,*




## *BUSS Hi-Cap FUSES PROVIDE...*

**Unlimited interrupting capacity to handle any fault current regardless of system growth! This was confirmed by tests witnessed and reported upon by the Electrical Testing Laboratories of New York.**

**Overload protection as well as short-circuit protection.**

**Coordination with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.**

**On old installations, a safe and relatively inexpensive way to protect inadequate circuit breakers against rupture in event of bad fault.**

**Dependable service through the years because there are no moving parts to stick or get out of order.**

**FUSETRON**
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
**BUSS**

**Blowing time charts and more information are available on FUSETRON Fuses and BUSS Hi-Cap fuses. Write for bulletin FIS and HCS.**

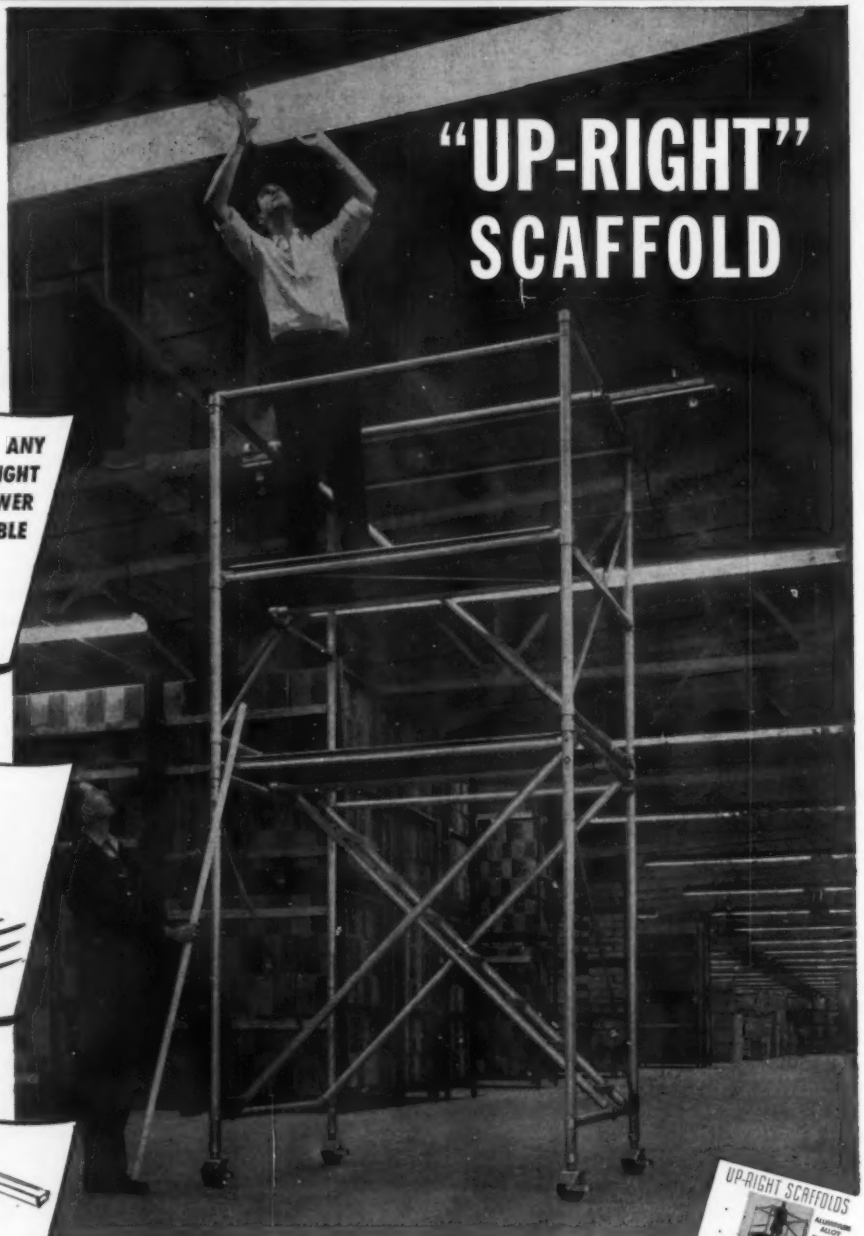
BUSSMANN MFG. CO., (Division of McGraw Electric Company) University at Jefferson, St. Louis 7, Mo.

# Fuses throughout the entire Electrical System!

WALTER D. VANCE, JR., *Vice President* • *California Electric Co., reports:*

## "We saved 14 days installing 527 fixtures by using 'UP-RIGHT' Scaffold-on-Wheels"

Man-hour savings on this General Motors warehouse job amounted to over 40%. Up-Right Scaffold is so light it is easily assembled by one man. Individual 1 piece aluminum alloy sections are unfolded and set one on top of the other. They lock into place instantly.







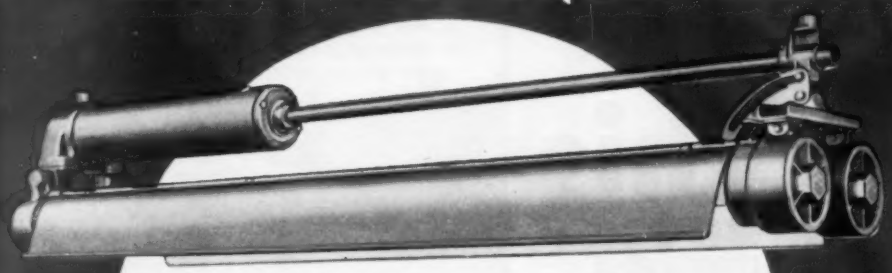

*Write for descriptive circular* ➡

**"UP-RIGHT" SCAFFOLDS**

Dept. 159 • 1013 Pardee Street • Berkeley, California

Factories: Berkeley, Calif. and Teterboro, N. J. • Offices in all principal cities

# CROUSE-HINDS High Efficiency LIGHTING EQUIPMENT...



Type EVF Explosion-Proof and Dust-Tight Fluorescent Lighting Fixtures
Slimline and Bi-Pin 1, 2, 3, or 4-Lamp

EV Series Explosion-Proof and Raintight Lighting Fixtures

## . . . for Hazardous Locations

Crouse-Hinds explosion-proof lighting fixtures exceed the requirements for service in highly explosive atmospheres. They are designed to operate at a temperature below the ignition temperature of the gas-air or vapor-air mixture. They are so strong that they will resist internal explosions without damage and so tight that they will prevent the escape of flames or burning gases which might ignite the surrounding atmosphere.

Crouse-Hinds dust-tight lighting fixtures assure safety in locations that are hazardous because of the presence of combustible dust.

DL Series Dust-Tight and Raintight Lighting Fixtures

Type MDB-14 Floodlight

## . . . for Wet and Corrosive Locations

Crouse-Hinds vaportight lighting fixtures are ideal for use in boiler rooms, powerhouses, shower rooms, tunnels, loading docks, building entrances, and all indoor and outdoor locations where exposed to moisture and rain, noh-explosive vapors and gases, or non-combustible dusts.

Hundreds of industrial lighting fixtures are listed in Crouse-Hinds Condulet Catalog.

V Series Vaportight and Raintight Lighting Fixtures

Type ADE-14 Heavy Duty Floodlight

## . . . for Protection

Sabotage thrives in darkness. The most reliable and cheapest form of protection against night prowlers is LIGHT! Crouse-Hinds floodlights project powerful beams of light that bathe all approaches to your property with glaring radiance, killing darkness and shadows and compelling everyone to be more visible at night than in broad daylight.

The protective power of light should be used in all important municipal and industrial locations. The floodlighting of industrial plants serves a double purpose. It helps to boost production in addition to the security it provides.

Send for your copy of Bulletin 2565, "LIGHT! Protect Your Property."

Type DCX Searchlight

A Nationwide Distribution Through Electrical Wholesalers

**CROUSE-HINDS COMPANY**
**Syracuse 1, N. Y.**

OFFICES: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver
Detroit — Houston — Indianapolis — Kansas City — Los Angles — Milwaukee — Minneapolis
New Orleans — New York — Philadelphia — Pittsburgh — Portland, Ore — San Francisco — Seattle
St. Louis — Tulsa — Washington. RESIDENT REPRESENTATIVES: Albany — Atlanta
Baltimore — Charlotte — Corpus Christi — Richmond, Va. — Shreveport
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

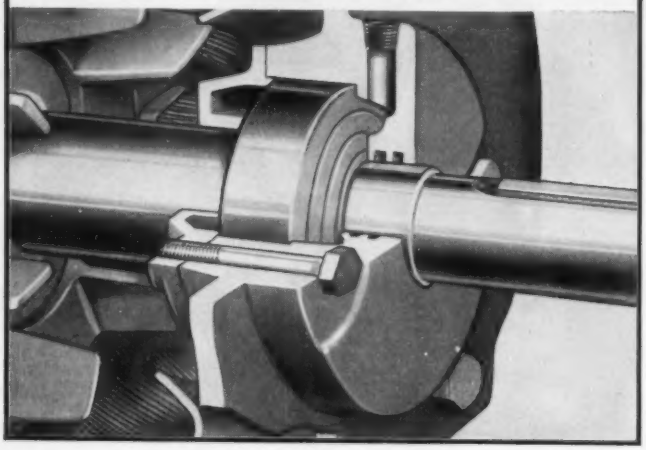
FLOODLIGHTS · AIRPORT LIGHTING · TRAFFIC SIGNALS CONDULETS

ALLIS-CHALMERS
General Purpose
MOTORS

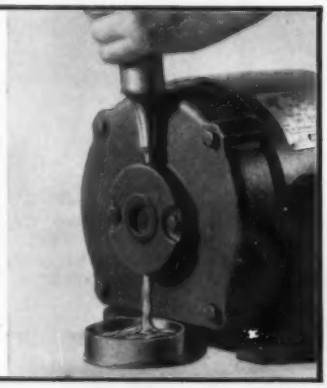
# This Bearing, fully enclosed and protected, yet easy to grease when desired ...gives more value for your motor dollar

The bearing cap is held tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the bearing against contamination from dirt and moisture.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.



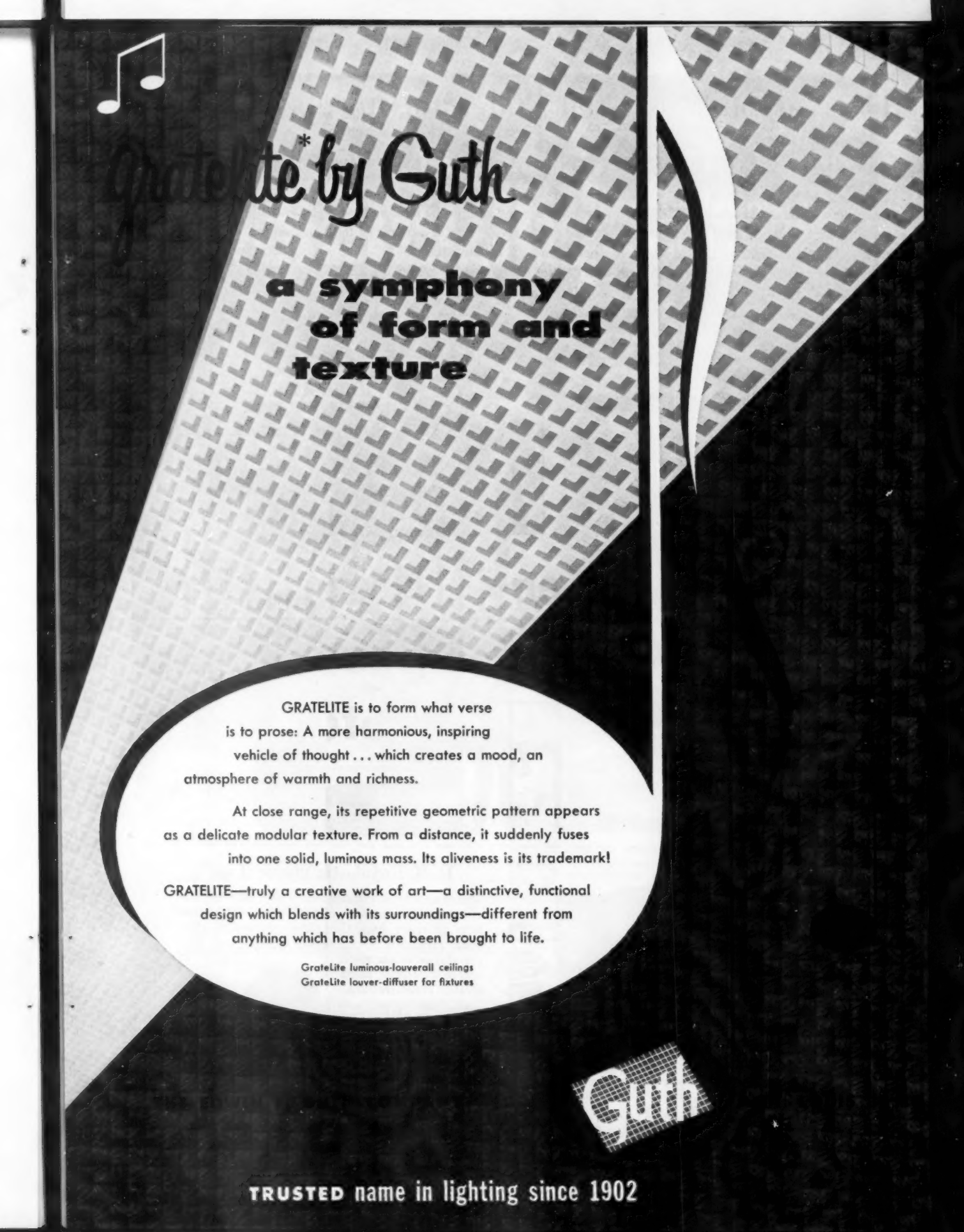
Lubricate without dismantling motor. Pipe-tapped holes in the bearing housings at two points provide both means for inserting new grease and a means of flushing out old grease.




**Look for the extra bolts** on the end housing... the sign of greater value. Ask your Allis-Chalmers representative or Authorized Distributor to show you a cutaway section of this maintenance-cutting design. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B6210.

**ALLIS-CHALMERS**

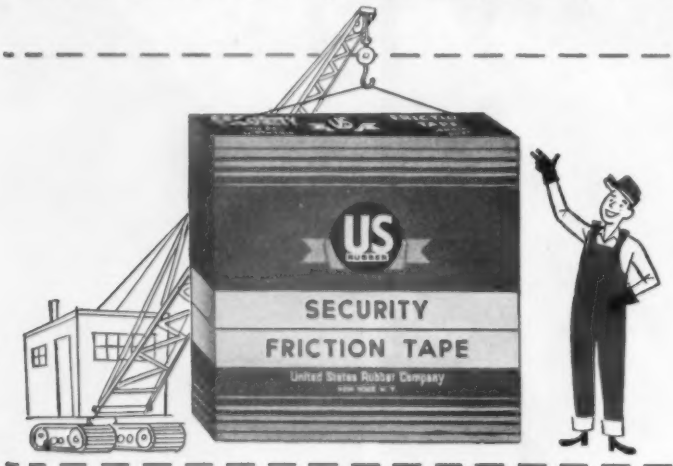
A-4574


Grate*lite by Guth
a symphony of form and texture
GRATELITE is to form what verse is to prose: A more harmonious, inspiring vehicle of thought . . . which creates a mood, an atmosphere of warmth and richness.
At close range, its repetitive geometric pattern appears as a delicate modular texture. From a distance, it suddenly fuses into one solid, luminous mass. Its aliveness is its trademark!
GRATELITE—truly a creative work of art—a distinctive, functional design which blends with its surroundings—different from anything which has before been brought to life.
GrateLite luminous-louverall ceilings
GrateLite louver-diffuser for fixtures
Guth
TRUSTED name in lighting since 1902

# Dependability is what you want in tapes—
# "Made by U. S. Rubber" means Dependability

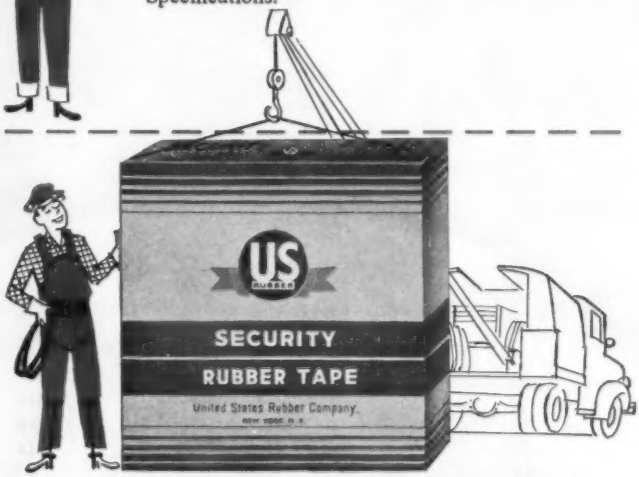
Reinsulating and splicing with "U. S." Tapes restore a cable or wire to its original dielectric strength and efficiency. They are made by United States Rubber Company, the only tape manufacturer to grow its own natural rubber and make its own synthetic rubber and plastics. "U. S." has amassed years of experience, research data and skill in the manufacture of tapes that guarantee *dependability* in *any* one of the tapes in the "U. S." Line.

Because the "U. S." Line is complete, you can simplify purchasing by ordering from this *single* line. Order from a selected "U. S." Distributor or any of the 27 "U. S." District Sales Offices.




## U. S. Security® Friction Tape

A long-time favorite for electrical and general purpose jobs. Strong, tacky tape that grips and stays on. High tensile strength. Straight-tearing, non-ravelling. Also in specification grade—U. S. Holdtite®—exceeds A.S.T.M. Specifications.



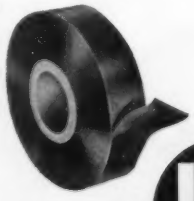

## U. S. Security Rubber Tape

For electrical work. Handles easily and fuses without heat. An unvulcanized rubber splicing compound; Security has high tensile strength, stretch, tackiness, high dielectric strength.

Also in a specification grade—U.S. Holdtite—exceeds A.S.T.M. Specifications.


## U. S. Royalastic Plastic Tape

Makes a thin splice that leaves wiring neat and uncluttered. Does the work of both rubber and friction tape on many jobs. Complete mechanical, electrical protection. Good tensile strength and high resistance to abrasion and to water, oils, acids, alkalies, corrosive chemicals. Good stretch and adhesion. Easy to handle. Appr. by Underwriters' Laboratories, Inc.

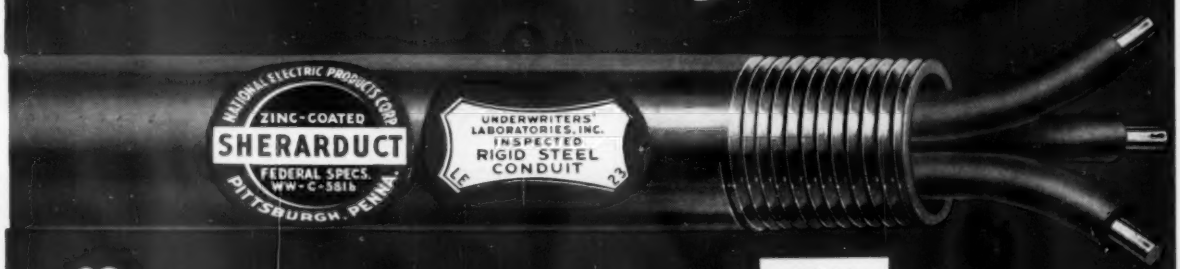


**UNITED STATES RUBBER COMPANY**
**MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.**

US RUBBER

A simple case of logic

# Sherardizing is Galvanizing at its best




SO . . .

# Sherarduct

is Galvanized Conduit at its best

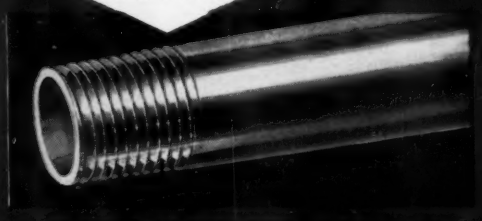
It's the Sherardizing process that fortifies Sherarduct . . . a dry galvanizing process that actually alloys corrosion-resistant zinc to the steel wall. This is galvanizing at its best!

Sherardizing provides 100 percent uniform zinc protection over all surfaces including the hills and valleys of every thread. This is Sherarduct . . . galvanized conduit at its best!

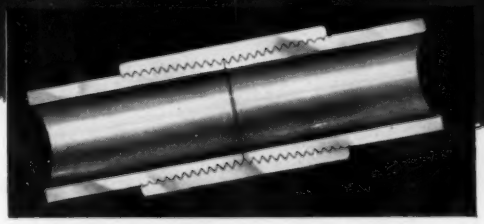
Finally, NE's baked-on Shera-enamel seals the zinc against acids and other corrosive elements. Sherarduct Conduit provides lifetime protection for all wiring.

***Insist on National Electric Sherarduct***

**CHECK THESE FEATURES**



1. THREADED BEFORE SHERARDIZING so that every clean, sharp thread has uniform full zinc protection.



2. THREAD PROTECTION . . . coupling threads and surfaces are fully zinc protected . . . Sherarduct coupling permits butting of conduit within the coupling.

3. Works easily . . . Fishes easily . . . Bends without flaking.

EVERYTHING IN WIRING POINTS TO

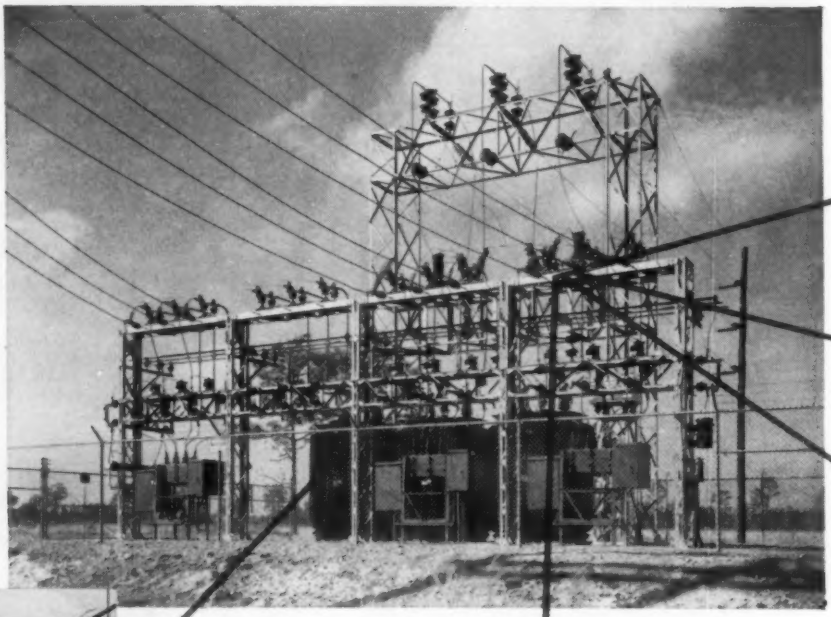
## National Electric Products

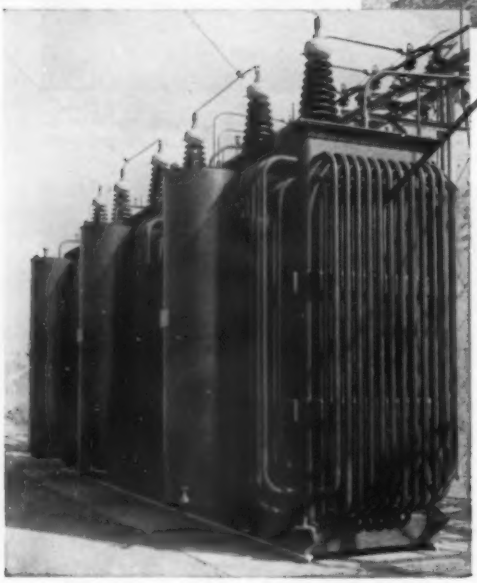
PITTSBURGH, PA.

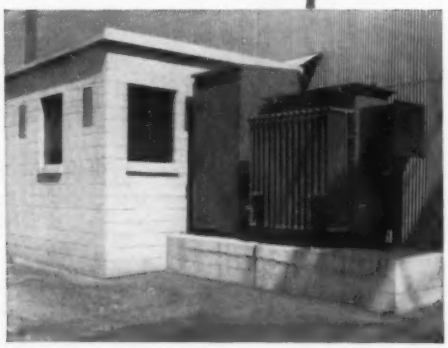
3 PLANTS • 8 WAREHOUSES • 34 SALES OFFICES

# KUHLMAN

## power transformers help insure uninterrupted service for continuous chemical processing operations of VIRGINIA-CAROLINA CHEMICAL CORPORATION





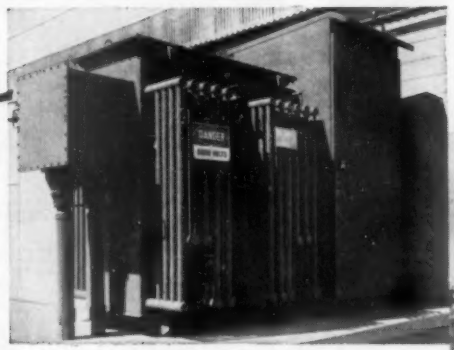


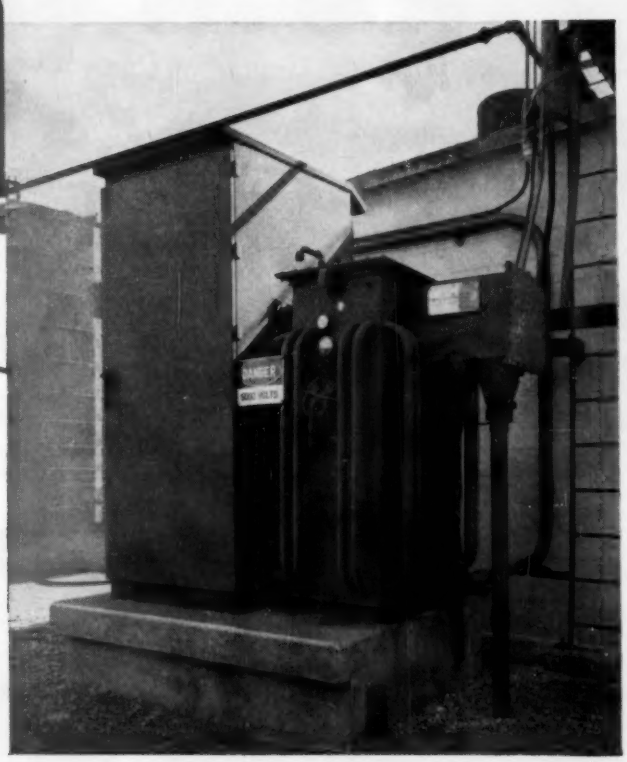
# KUHLMAN

The new substation of Virginia-Carolina Chemical Corporation at Nichols, Florida, is served from a 69 KV transmission line and utilizes three KUHLMAN 2500 KVA, single phase, two winding outdoor power transformers with low voltage winding of 2400 volts. The high voltage is connected delta to the incoming line through protective fuses and metering equipment. The low voltage is connected 4160 volts wye, with the neutral grounded through a current limiting resistor. The 4160 volt feeders, each equipped with automatic reclosing oil circuit breakers and suitable breaker by-pass switches, are run to the processing plants.

At each of the new processing plants at Virginia-Carolina Chemical Corporation, a KUHLMAN unit-type outdoor substation of suitable capacity ranging from 300 to 1000 KVA reduces the voltage to 480 volts delta. This voltage is fed through a main air-circuit breaker, which is throat connected to the transformer, and then by enclosed bus into the building which houses the 480 volt control centers.

The phosphate mining and chemical processing operations of the Virginia-Carolina Chemical Corporation go on continuously, twenty-four hours a day, seven days a week, producing materials that are vital to national security. Since electricity is the principal source of power for these operations, when outages, due to electrical troubles, occur, production grinds to a virtual standstill and costs mount rapidly. To guard against such outages at the new processing plants and at the new substation that was built to serve these plants, Virginia-Carolina Chemical Corporation installed KUHLMAN Power Transformers exclusively. The reason: the Company's electrical engineers, production and maintenance men knew from experience that KUHLMAN Power Transformers would give the service reliability required. KUHLMAN Power Transformers are specifically engineered for the requirements of industries and utilities, providing extremely long life and low-cost maintenance as well as unusual reliability. For complete information, write us today.

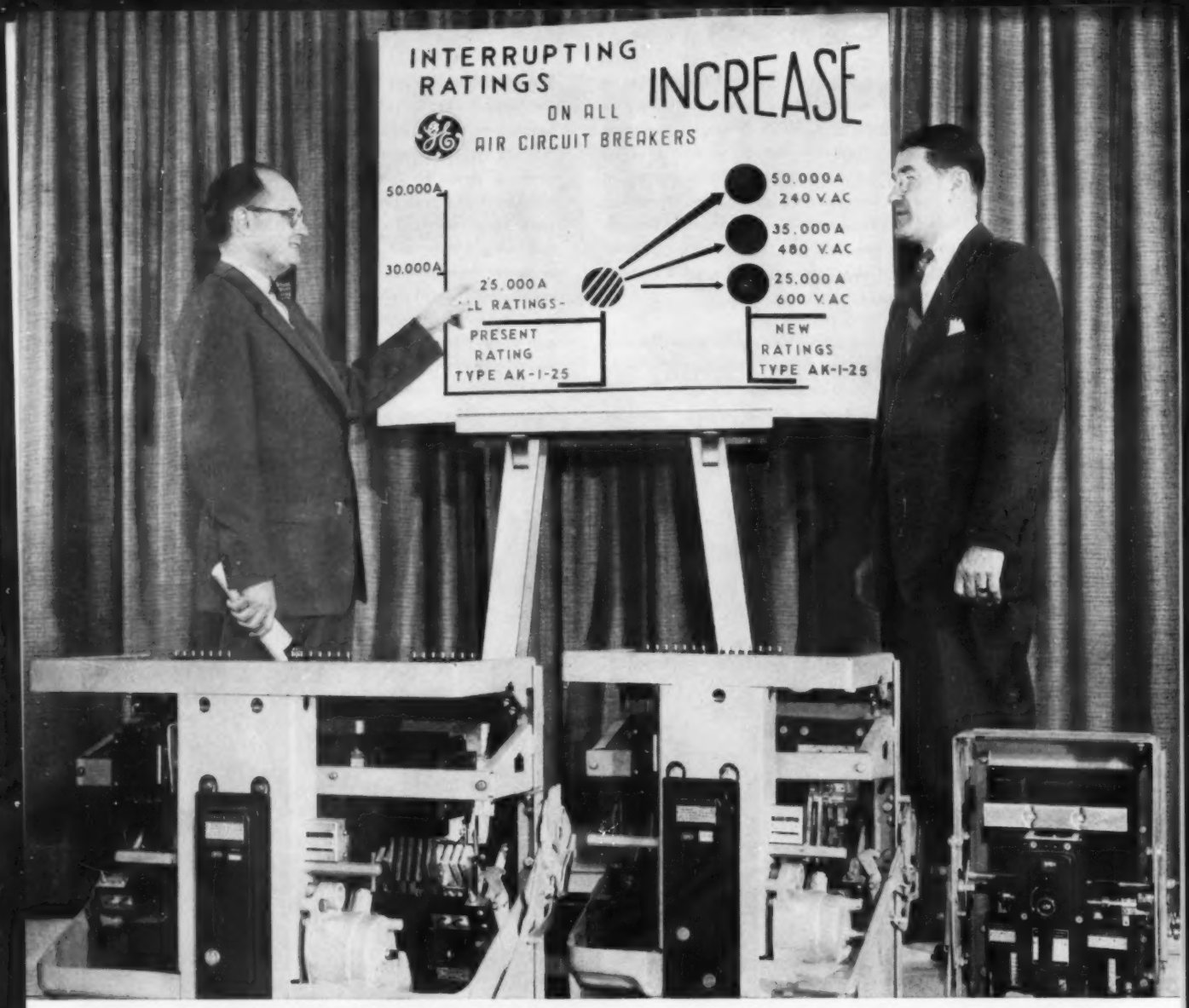




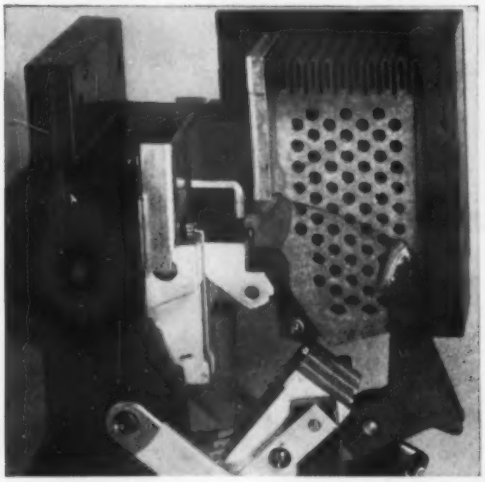
159

**ELECTRIC COMPANY**

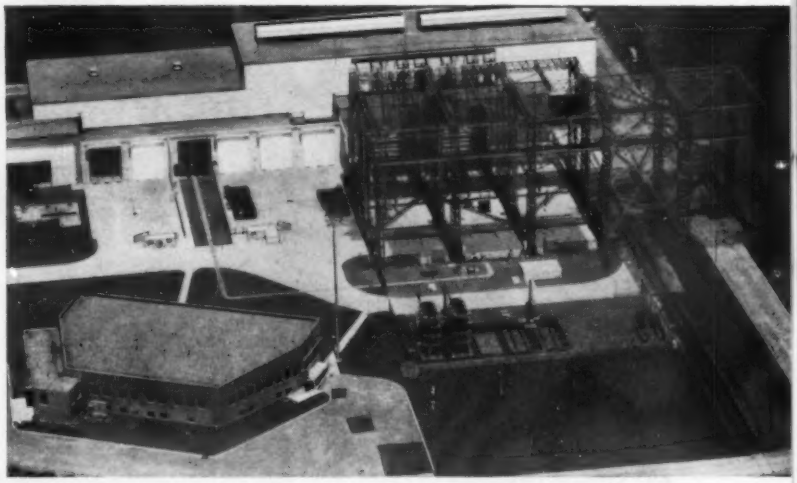
**BAY CITY, MICHIGAN • CRYSTAL SPRINGS, MISSISSIPPI • SALINAS, CALIFORNIA**




**Don Beeman, Manager—Industrial Power Engineering—and Ben Beall, Manager—Air Circuit Breaker Engineering, discuss the importance to customers of the new breaker interrupting rating increases. Chart refers to only one example of the new breaker interrupting ratings.**



**MULTI-SLOT INTERRUPTERS provide the extra interrupting ability that makes this increase possible.**



**EXTENSIVE TESTING of all breakers at the Switchgear Development Laboratory have proven this extra interrupting ability for operation at popular voltages.**

*General Electric Air Circuit Breakers*

# INTERRUPTING RATINGS INCREASED

## Appreciable Savings Now Possible in Many Low Voltage Switchgear Applications

**INTERRUPTING RATINGS HAVE BEEN INCREASED** from 25 to 50% on all popular ratings of General Electric Type AK air circuit breakers. Tests have shown that the efficient multi-slot interrupter is capable of interrupting higher currents at 480 volts A.C. and below.

**THESE NEW RATINGS OFFER SIGNIFICANT SAVINGS** in switchgear for customers using 208, 240 and 480 volts A.C. For example, in a typical commercial building utilizing a 208-volt system capable of a 100,000 ampere fault, the AK-1-25 feeder breaker may now be used where formerly an AK-1-50 feeder breaker would have been required.

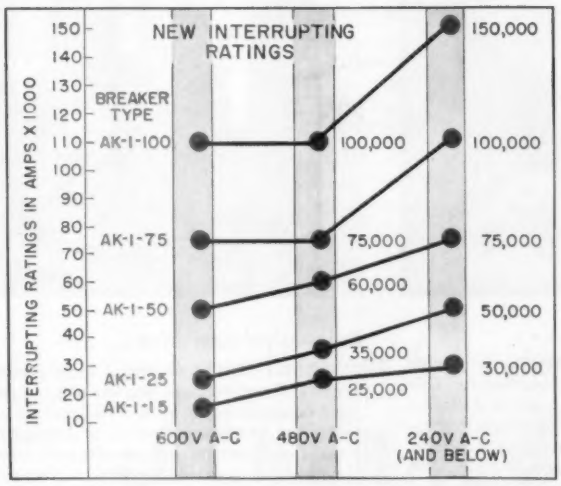
**SAVINGS** in a typical industrial plant application are shown in the table below.

**MORE EFFICIENT USE OF SPACE** is made possible through the application of smaller air circuit breakers with reduced space requirements.

**NEW APPLICATION INFORMATION** on air circuit breakers can be obtained from your nearest G-E Apparatus Sales Office, or write for Bulletin GET-2479. Address your request to General Electric Company, Section 526-1, Schenectady 5, N. Y.

*Progress Is Our Most Important Product*

GENERAL ELECTRIC



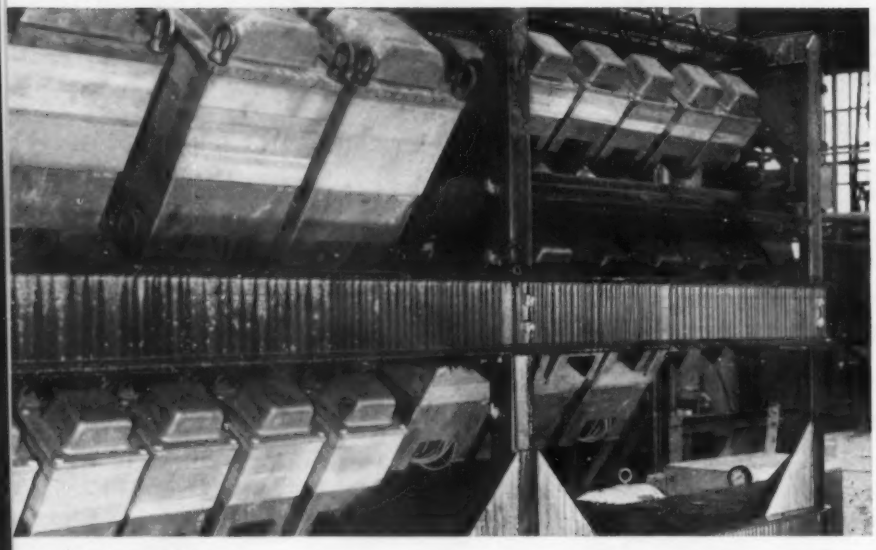

**NEW INTERRUPTING RATING INCREASES of 25 to 50% are shown for the popular 240 and 480 volt a-c systems.**

| System Voltage | Transformer Rating | Price Change of Switchgear with Main and 6 Feeder Breakers |
|---|---|---|
| 208 V. | 1000 Kva | 28% REDUCTION |
| 480 V. | 1000 Kva | 27% REDUCTION |

**TYPICAL EXAMPLES of cascade systems show appreciable savings in switchgear for customers with newly assigned interrupting ratings.**

**DRY-TYPE TRANSFORMERS**

# Standard lines cover wide range of unique design features; Meet your



***Longer life . . .***

**TYPE M TRANSFORMERS** perform longer because the entire core and coil assembly is thoroughly impregnated by an electronically controlled vacuum pressure process which removes all moisture, decreases electrical losses, combats corrosive atmospheres. Varnish insulation penetrates the entire unit, and not merely the exposed surface.

***Greater operating efficiency . . .***

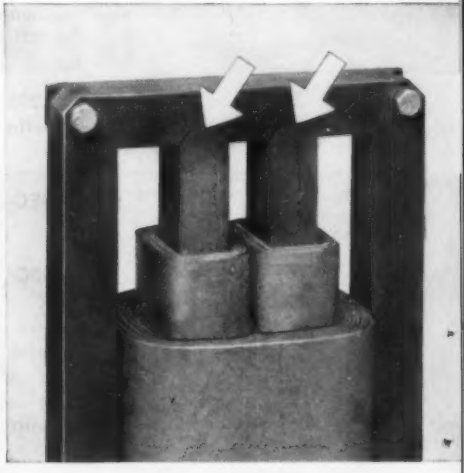
**TYPE M TRANSFORMERS.** Design feature exposes a large area of the core surface permitting more efficient cooling. Heat is dissipated by radiation as well as convection.

***Precalibrated . . .***

**VOLTAGE STABILIZERS** calibrated at the factory. Output voltage is stabilized within less than ±1%, for all input voltage variations from 95 to 130 (190 to 260) volts. Adjustments of voltage level are held within ±1% of nominal, the majority within ±½% of nominal for normal operating temperatures.


***Speedier installation . . .***

**MERCURY LAMP TRANSFORMERS.** Nameplate covers large wiring compartment. This functional positioning speeds installation and maintenance by putting complete easy-to-read wiring instructions and diagrams right where they are needed. Bolt on left holds plate to case, helps prevent its loss.



***Economical operation . . .***

**SATURABLE REACTORS** permit more precise control of load voltages because of a tongue-joint construction in core arrangements up to 7.5 kva. It reduces chances of damage to control components; allows virtually complete balancing out of a-c flux to eliminate induction of a-c voltage in the d-c coil.

# applications; Incorporate requirements economically

Using precise mass-production techniques, General Electric is producing a standard line of specialty and general-purpose Dry-type Transformers with exclusive design features that result in optimum performance. G-E transformers have met the demands of industry for many years and now G.E.'s standard line of transformers has grown to cover an extremely wide range of applications. Built to industry's highest standards, G.E.'s standard line of transformers are sold at competitive prices.

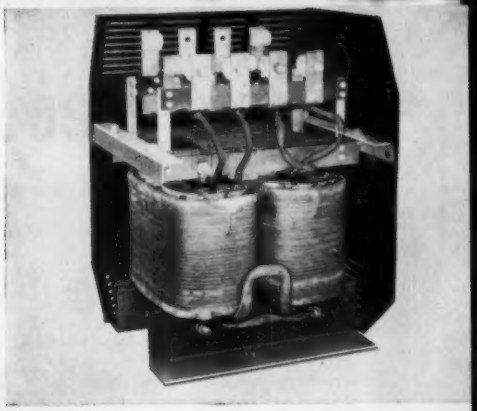
### DESIGNED TO YOUR REQUIREMENTS

Today, General Electric maintains a separate department for the sole purpose of developing and producing a standard line of Specialty and General-Purpose Transformers. It is staffed with experienced engineers who will accept the challenge of solving your special transformer problem. Usually a standard unit will do the job. But, if an existing G-E model will not serve your particular need, G.E. will design one to your exact requirements. As an example, General Electric has on file more than 1000 different designs for saturable reactors, ranging in sizes from 3 to 450 kva, alone.

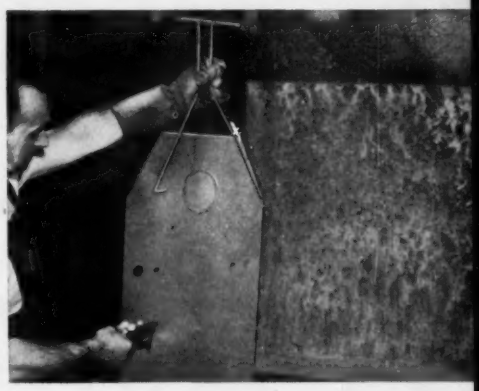
### TESTED FOR ACCURACY

The same precise measures which control the quality of standard transformers are taken with the production of each specialty unit you *specify*.

In the manufacture of its Type M Transformers, for instance, General Electric submits each unit to a minimum of 18 different tests and inspections: a procedure which assures you of better performing standard-line transformers. For additional information, simply contact your nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, New York.



***Easily accessible . . .***
**TYPE D TRANSFORMERS.** Both front and top of case are easily removed to make connections easier and to simplify maintenance.



***Longer wearing . . .***
**TYPE D TRANSFORMERS.** Cases of heavy-gage steel are finished in a durable enamel paint over a rust-prohibiting primer.

***Convenient mounting . . .***
**TYPE D TRANSFORMERS.** Narrow depth of case design permits unobstructive mounting against wall, saving valuable working area.

## *Make "G.E." your source of supply for all these dry-type transformers.*

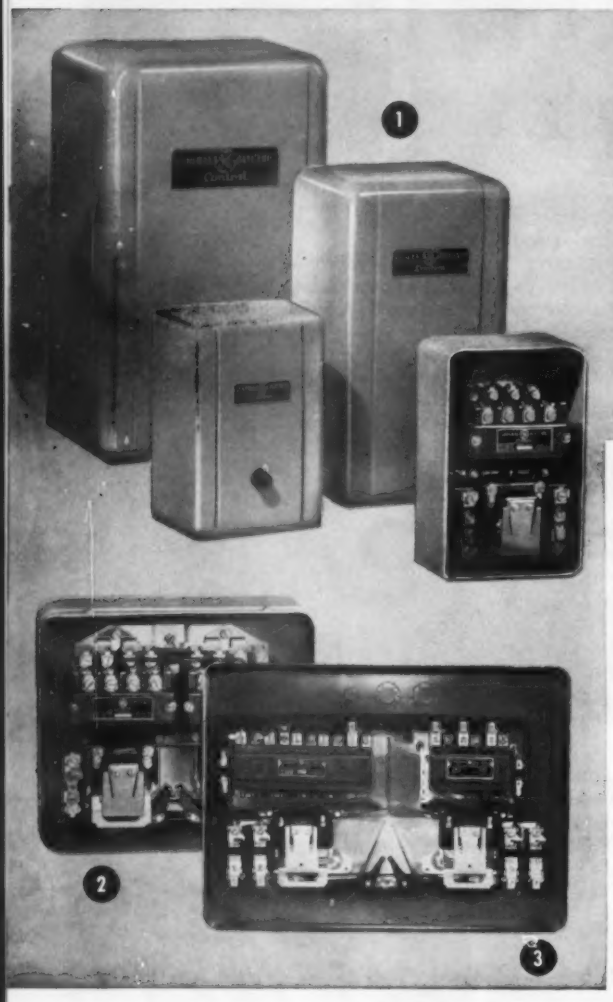
For detailed information on the following products write to:
General Electric Co., Section 410-7, Schenectady 5, N. Y.

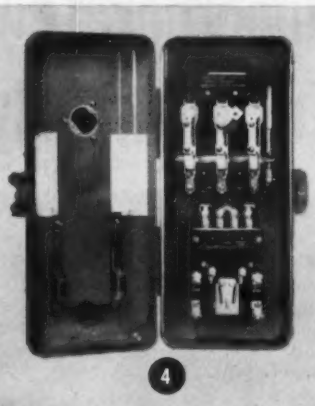
**Amplistats Bulletin GET-2424**
**Boost-buck Transformers GEC-1206**
**Distribution Transformers Bulletin GEC-1207**
**High Reactance Transformers**
**Ignition Transformers Bulletin GEC-1261A**
**Iron Core Reactors**
**Lighting Transformers Bulletin GEC-976, GEC-1208**
**Liquid and Insulation Testers**
**Machine Tool Transformers Bulletin GEC-1270**
**Magnetic Frequency Multipliers**
**Mercury Lamp Transformers Bulletin LS-103**
**Mine Load Centers**
**Phase-changing Transformers Bulletin GEC-1209**
**Photochemical Transformers**
**Power Packs**
**Power Transformers Bulletin GEC-1207**
**Railroad Signal Transformers Bulletin GEC-1251**
**Refrigerator Autotransformers**
**Saturable Reactors Bulletin GEC-1296**
**Telephone Line Insulating Transformers**
**Voltage Stabilizers Bulletin GEA-5754**

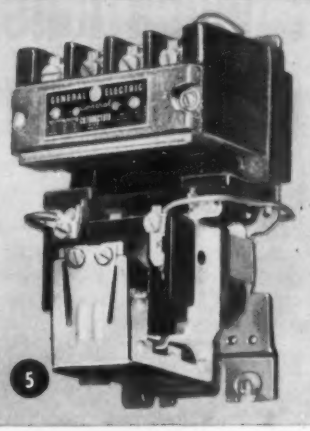
*Progress Is Our Most Important Product*

GENERAL ELECTRIC

# General Electric—one source of supply




## MAGNETIC CONTACTORS AND STARTERS

Select from a full line of open and enclosed devices—from fractional hp through 200 hp (600 volts, maximum). Available in every popular NEMA enclosure, including: general-purpose; semi-dust-tight; water-tight; dust-tight; explosion-proof; oil-immersed, corrosion-resistant; and JIC (automotive).

COMPLETE LINE OF MODIFICATIONS is offered on magnetic starters such as: push button or selector switch in cover, extra interlocks, third pole overload relays, separate a-c control circuit, and extra control relays.

1. **FULL-VOLTAGE MAGNETIC STARTERS** (CR7006) for squirrel-cage induction motors are available in size 00 to size 5 with bi-metallic overload protection.
2. **REVERSING CONTROLLER** (CR7009) combines two standard magnetic starters and mechanical interlock.
3. **MULTI-SPEED CONTROLLER** (CR7107) is ideal for full-voltage starting of 2-, 3-, or 4-speed squirrel-cage motors.
4. **COMBINATION STARTERS** (CR7008) provide disconnecting means and short-circuit protection by nonfusible or fusible disconnect, or circuit breaker.
5. **CONTACTORS AND MULTI-CIRCUIT CONTROL RELAYS** (CR2810 and CR2820) will handle loads from 5 to 240 amps.

## PUSH BUTTONS, SELECTOR SWITCHES, INDICATING LIGHTS

### STANDARD-DUTY PUSH-BUTTON STATIONS

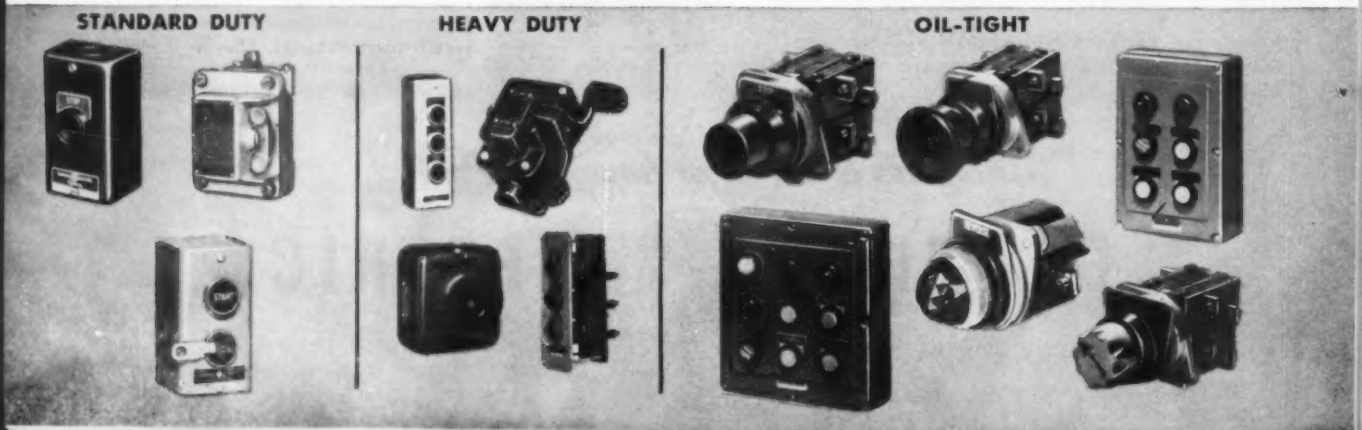
(CR2943). Stations are available with 1, 2, or 3 buttons and in pendant form. Double-break silver contacts assure reliable operation. Units are back-mounted on cover and need not be removed for wiring.

### HEAVY-DUTY PUSH-BUTTON STATIONS

(CR2940). Stations offer wide variety of 1- to 6-unit combinations of push buttons, selector switches, and indicating lights. Also furnished for flush mounting. Palm-, foot- and treadle-operated stations available.

### OIL-TIGHT PUSH-BUTTON UNITS AND STATIONS

(CR2940). Units have building-block design permitting any combination of contact arrangements. Also available are indicating lights and selector switches. Enclosures accommodate 1 to 16 units.



# for all your general-purpose control


## MANUAL AND REDUCED VOLTAGE STARTERS

1. **FRACTIONAL HORSEPOWER MANUAL STARTERS** (CR1061) are small-size, across-the-line starters operated by toggle switch—includes accurate bi-metallic overload protection.

2. **MANUAL STARTER UP TO 7½ HP** (CR1062) has snap-action toggle switch or push-button operator which trips free on overload. Available in 2-, 3-, or 4-pole forms.

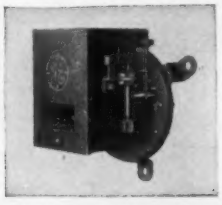
3. **MANUAL REDUCED-VOLTAGE STARTERS** (CR1034) are autotransformer types used where reduced starting currents or limited starting torques are needed. Undervoltage protection prevents automatic restart in event of power failure.

4. **MAGNETIC REDUCED-VOLTAGE STARTERS** (CR7051, CR7056) are autotransformer or resistor types designed for remote or automatic reduced-voltage starting. Timing relay provides proper timing for step-starting, eliminating excessive motor inrush currents.

**General-Purpose Relay.** (CR2790). For control circuit applications. Small in size with extremely long life. Rated 10 amps continuous (left).

**Solenoids** (CR9500). New strongbox solenoid provides firmly anchored terminal and lead-type connections in a single unit. 22% smaller units mount five different ways. Complete rating coverage in push and pull, 24 to 600 volts, 25 to 60 cycles and d-c (right).

**Plugging Switch** (CR2962). A pilot circuit device used in conjunction with reversing magnetic starter to automatically apply and remove plugging power for quick stopping of a motor.



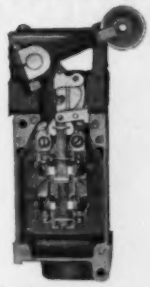
**Pressure Switches** (CR2927). A pilot device used to handle small motors directly or in conjunction with a magnetic starter for starting and stopping pressure generating equipment.

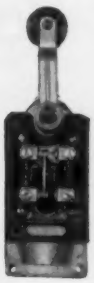
**Float Switches** (CR2931). Used in conjunction with a magnetic starter to start and stop small a-c and d-c motors. Float and counterweight may be interchanged for tank or sump operation.

## LIMIT SWITCHES

### LEVER OR ROTATING TYPE

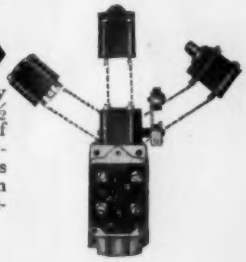
**Double Circuit Lever Type** (CR9440D). Snap action contacts can be changed from normally open to normally closed or vice versa. In open or oil-proof enclosed forms.

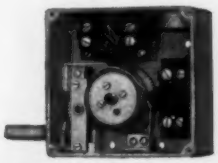




**Snap-Action Lever Type** (CR9440J). Used for heavy make-and-break requirements. Forms are available adjustable through 360 degrees. Operating lever firmly attached to shaft by double set of splines.

**Small Snap-Action Oil-Tight** (CR9440K). Only 1¼ and 1½ by 4½ inches. Oil-proof switch has 4 interchangeable heads that can face in any of four directions.





**Rotating Cam Type** (CR9441E) Two snap-action contact units operated through a worm gear reduction. Operating cams are easily set by adjusting only two screws.

**COMPLETELY NEW CATALOG OF G-E GENERAL-PURPOSE CONTROL**

**Advertising and Sales Promotion Section H734-1**

**General Purpose Control Dept.**
**General Electric Company**
**Bloomington, Illinois**

**Please rush me a free copy of the new general-purpose control catalog, GEC-1260A.**

**Name** .....
**Title** .....
**Company** .....
**Address** .....
**City** ..... **State** .....

**For more information on any of these general-purpose controls, contact your nearest G-E Apparatus Sales Office, or distributor.**

# GENERAL ELECTRIC

# G-E Capacitors at Colson Corporation raise power factor, save $3600 a year

"Power factor has jumped from a low of 84% to over 95% and we're saving $300 a month," reports Arthur Davis, Superintendent at the Colson Corp., Elyria, Ohio.

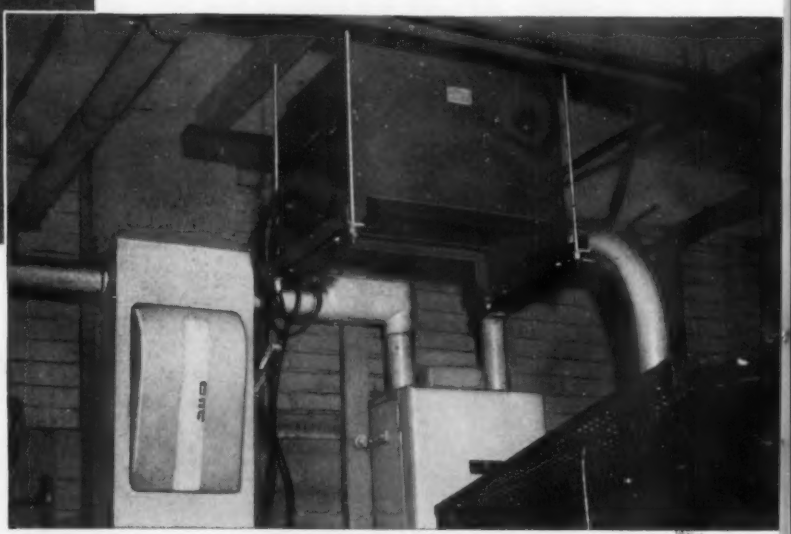
"Except for an occasional check of fuses, we have put them up and forgotten about them," Mr. Davis reports. "We were able to locate all of them on platforms keeping them out of the way and nearer to power lines."

With the assistance of the Elliott Electric Co., 450 kvar of capacitors at 230 volts were installed which released the strain put on transformers during peak production periods and eliminated the necessity of rewiring or the addition of expensive new equipment.

It will pay you to investigate the possibility of a capacitor installation in your plant. If your power factor is below 85% and if there is a power factor or kva-demand clause in your power bill, chances are, you too can make substantial savings in your power bill by installing capacitors. Besides reducing your power bills, capacitors can release extra system capacity and permit your distribution system to carry 20 to 30 percent more load.

For more information about G-E industrial capacitors, contact your nearest G-E Apparatus Sales Office, or write for Bulletin GEA-5632 to Section 441-109, General Electric Company, Schenectady 5, N. Y.

**Jack E. Davis, Plant Manager,** discusses G-E capacitor installation in wood shop with Art Davis, plant superintendent.



**G-E capacitors** installed out of the way and near power line in the Truck Shop at Colson Corp., Elyria, Ohio.

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

This electrical surge test is one of the 258 tests that every G-E ballast receives during the manufacturing cycle. This test subjects G-E ballasts to the most severe conditions they will ever encounter in actual operation; assuring you of long ballast life and low lighting costs.

***Flora* shows you why . . .***

# Superior Quality Control of G-E Ballasts Helps You Save Lighting Dollars

Lighting engineers, designers, and users have learned to depend upon the consistently high quality of General Electric fluorescent lamp ballasts.

They know that the rigid material specifications and constant production line tests mean uniformly good ballasts; save lighting dollars by minimizing early replacement and maintenance costs.

Starting with raw steel and copper wire at the receiving dock and ending only when the finished ballast is loaded for shipment, G-E quality control engineers constantly test raw material and ballast parts to meet rigid mechanical and electrical requirements.

By actual count a G-E ballast receives 258 different tests and checks before packing and shipment! This painstaking care pays off to you in highly dependable operation, efficient lamp output, and long ballast life—it saves you valuable lighting dollars.

Next time you specify equipment for a fluorescent lighting installation, make sure you get the best...specify General Electric quality-controlled ballasts.

A G-E ballast tag or sticker on your fixture is proof that it's equipped with the best in ballast value. It's the easy way to be certain. For further information on G-E ballasts, write Section 401-9, General Electric Company, Schenectady 5, New York.

*Miss Fluorescent Ballast, G. E.'s Ballast Mascot



CLOSE INSPECTION of each component assures you of high quality ballasts, lower lighting costs and dependable performance.

***Five more reasons why***

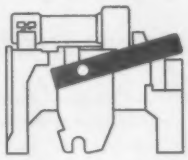
## GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

- EXCLUSIVE SOUND RATING SYSTEM
- LONGER BALLAST LIFE
- PRECISE LAMP-MATCHED DESIGN
- PROVED PRODUCT LEADERSHIP
- COMPLETE CUSTOMER SERVICES


*Progress Is Our Most Important Product*

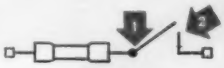
GENERAL ELECTRIC

## PLUS VALUES OF THE NEW 30 AMP. TYPE D



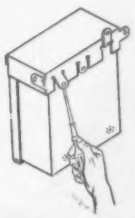
**VISIBLE KNIFEBLADES**

Shows at a glance if switch is "On" or "Off". Dual knife-blade construction assures trouble-free operation and long switch life.



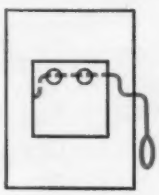

**MINIMUM NUMBER OF JOINTS**

Wrap around lug and bus construction minimizes number of heat-creating joints; assures cool operation.



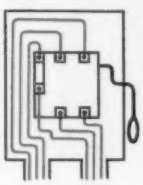
**RAINTIGHT ENCLOSURES**

Easiest-to-mount on irregular surfaces and poles. If back mounting ears are used pry them up with screw driver and bend down side ears.



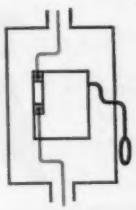
**FUSES ACCESSIBLE**

Operating crossbar **under** the switch block provides full access to fuses.



**AMPLE GUTTER SPACE**

Wide, unobstructed gutter space eliminates need for threading wire under operating crossbar.

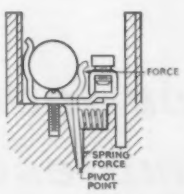


**FEED-THROUGH NEUTRAL**

Whether coming in at top or bottom, feed-through neutral is always readily accessible for easy wiring.

**SOLDERLESS LUGS**

Straight feed-in solderless lug on both line and load sides saves wire and wiring time. No wire looping; no fumbling with binding screws.




**HIGH PRESSURE FUSE HOLDER**

Coil spring type located in block beneath the fuse and unaffected by its heat. Holds fuse in a vise-like grip.

**Write for your free copy of booklet giving the whole story on the new Federal Noark® feature-packed Type D Safety Switch line . . . the one line that gives you everything!**


**FEDERAL PACIFIC ELECTRIC CO.**

Formerly—Federal Electric Products Company and Pacific Electric Manufacturing Corp.
Main Office: 50 PARIS STREET, NEWARK 1, N. J.

**Federal Pacific products:** Stab-lok Circuit Breakers, Motor Controls, Safety Switches, Service Equipment, Industrial Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct, High voltage circuit breakers and power switches
★ Sales offices in principal cities.

**Announcing another new development...**

**Backed by the famous SYLVANIA money-back offer**

## ...more power per square inch

Now Sylvania has packed more power than ever before into an eight-foot fluorescent lamp—40% more power per square inch of phosphor than the highest-powered eight-foot lamp previously available.

## ...maximum output area

More than 440 square inches of radiating area pour out light from this new Sylvania development in lamps—to bring you a total light output nearly 1½ times greater than existing lamps of the same size—to permit a two-lamp fixture to do the same lighting job as previous 3-lamp fixtures.

# ...to bring you today's most powerful fluorescent lamp

With the development of the new high-output, 8-foot fluorescent lamp, Sylvania now offers you *more light power than ever before from a single fluorescent lamp*. The new Sylvania 96", T-12, 100-watt lamp now opens up new economies for commercial and industrial installations where high light levels at low cost are a prime consideration.

AND—like all Sylvania fluorescent lamps—these new, high-output lamps are backed by Sylvania's famous money-back offer. If, in your opinion, they do not outperform your present lamps, for uniformity of performance and appearance, for maintained brightness and life—send them back with your signed certificate and Sylvania will refund the full purchase price. Check with your Sylvania supplier on the new 96", T-12, 100-watt lamp today.

SYLVANIA ELECTRIC PRODUCTS INC.
Lighting Division, Salem, Mass.
*In Canada: Sylvania Electric (Canada) Ltd.*
*University Tower Bldg., St. Catherine Street, Montreal, P. Q.*

LIGHTING • RADIO • ELECTRONICS
TELEVISION • ATOMIC ENERGY

**Keep your eye on SYLVANIA**

**...fastest growing name in sight**

# KILLARK DESIGNS

# NEW EXPLOSION PROOF LIGHT

Series "H" Fixture Combines:—
Excellent Lighting Efficiency
with Cooler Operation,
Greater Safety,
Easier Installation
and Maintenance.

**NEWLY-DESIGNED SERIES "H" FIXTURES HAVE THESE OUTSTANDING FEATURES:**

**BETTER LIGHTING**—Auxiliary anodized aluminum reflector increases light output, resulting in more efficient distribution of light.

**SAFER LIGHTING**—Cooler operation increases safety factors; rugged construction confines explosions within system.

**STREAMLINED**—Attractive, compact. No ledges to catch dust.

**LIGHTWEIGHT**—Made of non-rusting, non-sparking aluminum alloy.

**EASY RELAMPING**—No tools needed.

**WATTAGE QUICKLY CHANGED ON JOB**—All sizes fit standardized splice boxes.

**U. L. APPROVED**—Listed by U. L. for Class 1, Groups C & D locations.


**COMPLETE LINE:**

Three Styles: Pendant, Ceiling, Bracket.

Four Sizes: 60-100; 150; 200-300 medium base; and 300-500 watts, mogul base.

Four Reflector Types: Standard Dome, Shallow Bowl, Deep Bowl, Angle.

ILLUSTRATED LITERATURE and prices on request.

Killark

*"Killark . . . a fitting name to remember"*

## ELECTRIC MANUFACTURING COMPANY

ENTRANCE FITTINGS • CONDUIT BODIES • FLUSH SWITCH FITTINGS • EXPLOSION PROOF FITTINGS • VAPOR TIGHT LIGHT FIXTURES • EXPLOSION-PROOF LIGHT FIXTURES • SEALED BEAM FIXTURES

Vandeventer and Easton Aves. St. Louis 13, Missouri

| | | | | | | |
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| | BOSTON | 49-51 D St. | DENVER | 1073 Galapago | PITTSBURGH | 50 26th St. |
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# Room for the Future
# –with Lighting by **LITECONTROL**

This light and cheerful Sun Oil office in Cincinnati has plenty of room to grow . . . and its comfortable, attractive LITECONTROL installation can grow right along with it. Notice the spacing of the recessed fixtures: new fixtures can be added to each row, making them continuous. Or new lines of fixtures can be added between the present rows.

This versatile installation with the built-in growth potential uses LITECONTROL 5524, a 2-lamp recessed troffer. Curved Holophane lenses direct the light to minimize brightness, so seeing is comfortable all day long. Notice, too, how the fixtures harmonize with the tiled ceiling.

Light colors on the walls and ceiling and a light-toned, attractive floor pattern complete this picture of an outstandingly pleasant place to work. Installation was economical, of course, and cleaning and maintenance are easy: just lift out the fixture lenses from below.

Whatever the lighting requirements, LITECONTROL service and fixture efficiency will give you *custom lighting* at *standard prices.* Get in touch with your local LITECONTROL representative.

INSTALLATION: Sun Oil Company, District Sales Office, Cincinnati, Ohio

PROJECT ENGINEER: Alex M. Engart

GENERAL CONTRACTOR: Dawson-Evans Construction Company, Cincinnati, Ohio

AREA: 1250 square feet

FIXTURES: Litecontrol #5524 recessed troffers, with Holophane #9033 and #9034 Low Brightness Lenses

CEILING HEIGHT: 9'–0"

SPACING: 8'–0" on centers

LITECONTROL *Fixtures*

**KEEP UPKEEP DOWN**

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

# How Simplex-TIREX Cords reduce maintenance costs...

When electric cords on portable maintenance tools, such as drills, saws, grinders and polishers, show signs of excess wear or inability to withstand abuse, they need special handling. That means slowing up the work.

Portable tools powered through TIREX Cords are ready to be used any time, any place. Ordinary rough treatment has little or no effect on the life of these tire-like cords.

TIREX Cords have the toughest jacket known. TIREX will not snag or tear. It resists oil, heat and sunlight.

Detergents won't hurt its cured-in-lead Selenium Neoprene Armor.

TIREX is as flexible as a piece of string.

Get TIREX Cords from your local electrical wholesaler. See how they meet your needs, how they help to keep your operation costs down.

Your local electrical distributor has TIREX Cords in stock, or can get them for you quickly. Be sure you get TIREX.

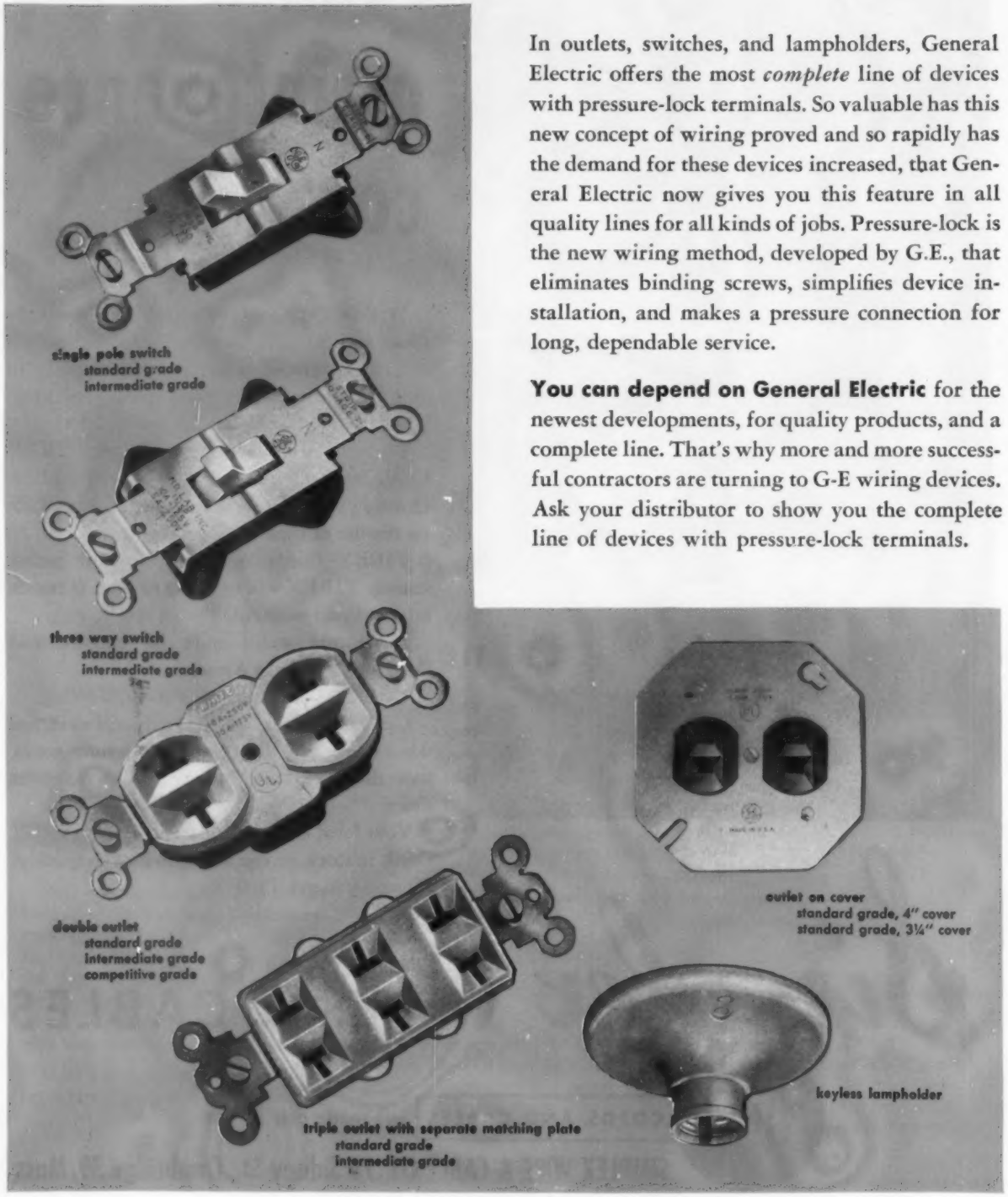
Simplex WIRES & CABLES

TIREX CORDS AND CABLES *are made only by the*

**SIMPLEX WIRE & CABLE CO., 79 Sidney St., Cambridge 39, Mass.**

## G. E. offers you

# WIDEST CHOICE OF WIRING DEVICES




In outlets, switches, and lampholders, General Electric offers the most *complete* line of devices with pressure-lock terminals. So valuable has this new concept of wiring proved and so rapidly has the demand for these devices increased, that General Electric now gives you this feature in all quality lines for all kinds of jobs. Pressure-lock is the new wiring method, developed by G.E., that eliminates binding screws, simplifies device installation, and makes a pressure connection for long, dependable service.

**You can depend on General Electric** for the newest developments, for quality products, and a complete line. That's why more and more successful contractors are turning to G-E wiring devices. Ask your distributor to show you the complete line of devices with pressure-lock terminals.

# WITH PRESSURE-LOCK TERMINALS

## Make better connections easier

**Pressure-lock terminals make wiring easy,** whether you are using No. 10, No. 12, or No. 14 Awg wires. Just strip off the insulation, push wire into the terminal openings, and the G-E pressure-lock terminal grips the wire for a firm, dependable connection. All live parts are *completely* enclosed — hazards of shocks and short circuits are avoided. You'll see at once how the pressure-lock terminal principle solves device problems caused by the heavier wire requirements of new installations and circuit modernization jobs. Vibration won't loosen connections—yet, when necessary, wires can be removed easily from terminals simply by inserting a screw driver into release slots.

**FOR MORE INFORMATION** about the complete line of G-E devices with pressure-lock terminals, write Wiring Device Department, General Electric Company, 57 Hathaway St., Providence 7, Rhode Island.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

# never before an industrial with these unparalleled advantages


*Patent applied for*

Write Today ... for brochure giving complete details of the remarkable new Ortho-88. In addition to installation and mounting data, it illustrates several examples of how Ortho-88 versatility can work for you. Catalog pages giving complete engineering data are included.


Here's what advance design can do for you . . .

*Save up to 50% on installation costs:* The Uni-Race (shown above) is part of your Ortho-88. It is a rigid, lightweight, open channel-way containing a fixed power source (receptacle) for each fixture. Sections, 20-24 ft. long, are assembled and wired on the floor and hung as a unit. Fixtures, mounted without tools in minimum time, fall into perfect alignment automatically. The whole operation is accomplished easier, faster and more accurately with savings in time and materials up to 50%.

*Save on materials:* The amount of conduit required is reduced substantially. Receptacles, chain suspension accessories, cord and plug, etc. are completely eliminated.

*Unheard-of flexibility for you:* Fixtures may be mounted on the Uni-Race in continuous rows, or spaced at intervals of 4', 8' or 12'. They can be moved about, or additions made, as conditions demand without further electrical work and without interrupting service. Repairs, or replacements are made by changing fixtures without disturbing other fixtures on the circuit.

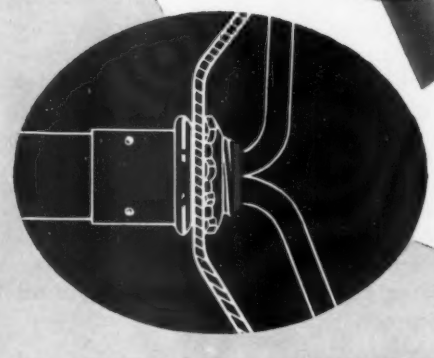
**GIBSON** *Manufacturing Co.*

1919 Piedmont Circle, N.E., Atlanta, Georgia

# Red Throat

## B-M 21 B, THE NEW INSULATED THROAT INDENTER CONNECTOR FOR E. M. T.

*Four Ways Finer*

1. Protruding rounded red plastic lip of bushing prevents cutting of insulation—eliminates shorts.
2. Full thread screws into all conduit fittings. Lip of RED THROAT bushing protects thread from damage.
3. Deep dished eight pronged lock nut is easier to drive on—screws flush to shoulder and digs into metal of box for vibration proof positive ground.
4. Permanent locked-in bushing insures smooth burr-free raceway for easy fishing. No extra work and costs no more.

Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job!

**ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT**

*Order from Your Wholesaler!*

All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

*Warehouse Stocks in Principal Cities for Immediate Delivery!*

*Top: Clark Control Center for furnace control at Bohn Aluminum and Brass Corporation, Adrian, Michigan.*

*Insert: Separate access doors to vertical wireways simplify installation, inspection, service and maintenance.*

# SEPARATE VERTICAL WIREWAYS

## *Simplify installation and servicing of*

# CLARK CONTROL CENTERS

Roomy 6-inch wide vertical wireways for each section, independent of starter compartments and equipped with separate access doors, save time and money on installation of Clark Control Centers, and make them easier to service and maintain.

Ample wiring space is provided for all load and interwiring connections. Terminal boards may be located in vertical wireway adjacent to starters or at top or bottom of any section. Versatile bus-bar compartments permit the use of one to four sets of electrically isolated horizontal bus, permitting power to be fed from any or all of four different sources.

Clark Control Centers are the easiest to pre-plan and lay out because adding transformers and/or relays or changing type of construction (NEMA type A, B, or C) does not change space requirements.

*Write for your copy of the 24 page illustrated book entitled "Control Centers by CLARK."*

*The* **CLARK** **CONTROLLER** *Company*

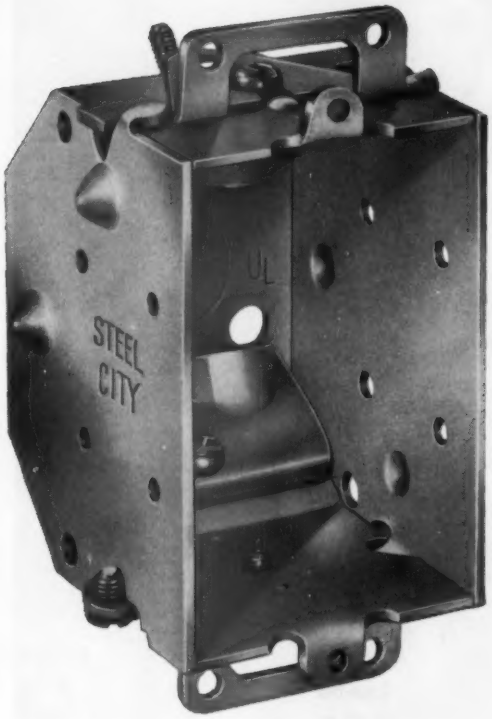
***Engineered Electrical Control***

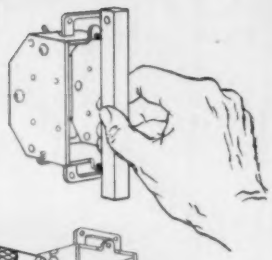
**1146 East 152nd Street • • Cleveland 10, Ohio**

# quality

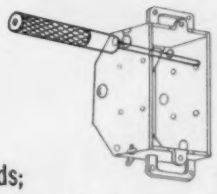
## is more than a word

**It's a round-the-clock business at Steel City Electric—with constant checks**



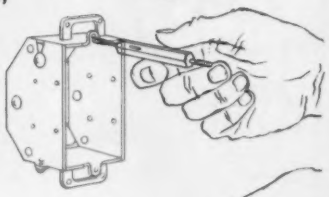



that mounting holes
are always "true"

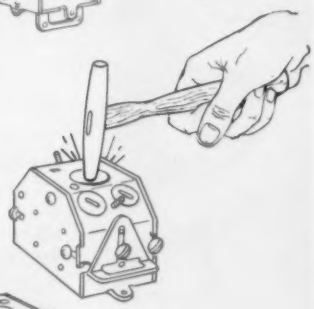


always clear
and free of obstruction

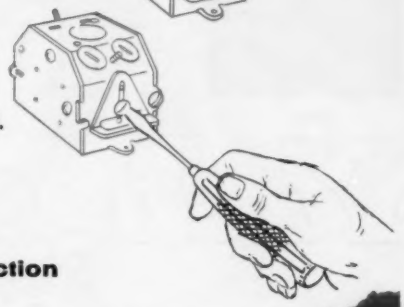
— with cleanly tapped threads;



that knockouts
remove easily
without damaging the box;



and that
parts fit tightly
and rigidly together
— because the dies
are accurate
and cut both sharp and clean;



with screws in place
but not too tight
— for easy installation.

**A Steel City switch box**
**quality-checked at every stage of production**

## at STEEL CITY ELECTRIC COMPANY

Pittsburgh 32, Pa.


# Youngstown

## BUCKEYE CONDUIT

QUALITY YOUNGSTOWN SERVICE

●You can keep your jobs on schedule, avoid lost time and unnecessary overhead by relying upon your Youngstown Distributor for Youngstown Buckeye rigid steel conduit. You'll get the size and quantity of good steel conduit you want **when** you want it. Phone your Youngstown Distributor. He'll take care of your order promptly.

**THE YOUNGSTOWN SHEET AND TUBE COMPANY** *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices: Youngstown, Ohio - District Sales Offices in Principal Cities

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - BAR SHAPES - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - RAILROAD TRACK SPIKES

# Industrial
# R&S LIGHTING FIXTURES

**...3 Complete Lines meet every safety lighting need!**


## EXPLOSION PROOF

***CLASS I, GROUPS C & D***

For greater safety in hazardous locations wherever flammable materials are made or used. A complete line is available in pendent, ceiling, bracket and hand types — from 100 Watts through 500 Watt sizes. Standard conduit bases permit interchangeability of reflector globe assemblies.

## DUST-TIGHT

***CLASS II, GROUPS E, F & G AND CLASS III***

For hazardous locations where flammable or explosive dusts are present. Streamlined design prevents dangerous accumulation of dust particles. Two exclusive design features facilitate easy cleaning and relamping. Standard pendent and junction box bases accommodate any style of fixture — globe — assembly interchangeably in either 100 Watt or 200 Watt sizes.

## VAPORTIGHT

For efficient illumination and maximum indoor and outdoor protection against non-inflammable gases, vapors, dusts and moisture. A complete line available in pendent, ceiling and bracket types from 15 Watts through 500 Watt sizes. Bases remain vaportight when globes are removed or broken in service.

**R&S also makes a complete line of marine fixtures and fittings**

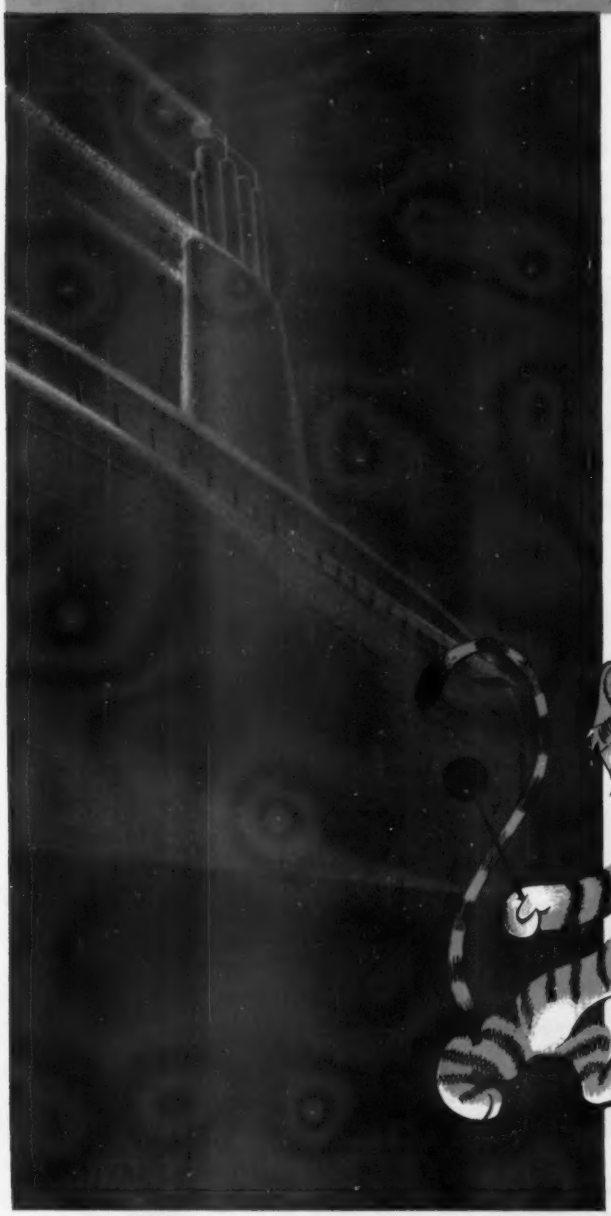
RUSSELL & STOLL COMPANY, INC. • 125 BARCLAY STREET, NEW YORK 7, N. Y.

# RUSSELL & STOLL

*PRECISION-BUILT ELECTRICAL EQUIPMENT—SINCE 1902*


U·S·S

# Nautilus



*first*
*atomic submarine*
*uses*

## TIGER BRAND ELECTRICAL CABLE

The Nautilus was built by General Dynamic Corporation's Electric Boat Division shipyard, at Groton, Conn. She was launched on January 21, 1954.

Very frankly, we cannot recall a more *critical* application of electrical cable than this new atomic-powered submarine. And from one end to the other, this amazing boat is laced with Tiger Brand Electrical Cable.

But here's the important thing—*you* can get the same quality that went into the Nautilus. Just call your American Steel & Wire salesman.

**AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL**
**GENERAL OFFICES: CLEVELAND, OHIO**

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK


**A STANDARD TIGER BRAND CABLE FOR EVERY SPECIAL JOB!**

paper & varnished cambric cable
asbestos wire and cable
shovel & dredge cable
mold cured portable cord
machine tool & building wire
special purpose wire & cable
aerial, underground & submarine cable

***USS Tiger Brand*** **ELECTRICAL WIRE & CABLE** USS

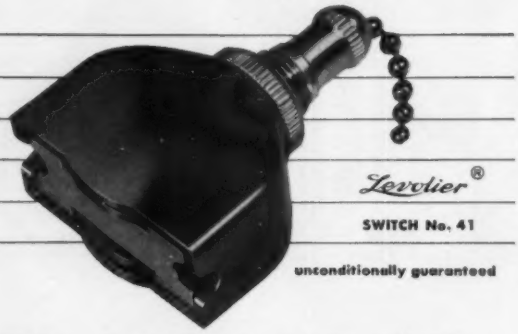
**UNITED STATES STEEL**


## new design

## Rugged Too! Defies Replacement

What you don't see in this modernly-styled Levolier® industrial lampholder is as important as its attractive lines. Built to eliminate replacement, the lampholder cap and casing is double thick impact-resisting molded phenolic. The screw shell inside is .006" heavier than standard. The housing, which screws together at the lever, encloses the proven Levolier® switch mechanism with either push button action or universal lever control. Models include ⅛", ⅜", ¼" and pendant caps.

*install it — forget it*




## IT'LL LAST A LIFETIME

You have no replacement worries when you use the No. 41 Levolier® switch. It has no match for quality and is so trouble-free and durable it is unconditionally guaranteed against failure. Ideal in any canopy mounting for individual control of fluorescent or incandescent lighting — also FHP motors. Its rugged, one-piece molded phenolic case gives better insulation and makes wiring easier. 6 amp, "T" rated, 125 volts. Underwriters' Laboratories approved.

*only* McGILL *makes* Levolier® *Switches*


## THE SAFE WAY

*to change lamp bulbs is with* McGILL® *adaptable lamp changers*

You keep your feet on the ground even when you're changing lamp bulbs up to 30 feet above the floor with the McGill Adaptable Lamp Changer. Lightweight steel pole is furnished in 5' insulated sections that lock together securely by spring-actuated buttons. Several style heads available for virtually any size, shape and type of bulb.


*grounded lamp guard*

**with the**

## N.E.C. Approved grounding arrangement

The #5025-SRG series portables use the 3 wire plug and convenience outlet adopted as standard by Underwriters' and the National Electrical Code — 2 parallel blades with a U shaped third blade for ground. It will outlast several "inexpensive" portables because all component parts are quality built. Heavy steel wire cages, electrically welded and zinc plated with bright chromate finish. Levolier switch and keyless types with or without 16-3 SJ black rubber cord.

50th McGILL Anniversary

YOU CAN DEPEND ON

McGILL QUALITY

**Available through leading Electrical Wholesalers**
For complete information on products of the McGill Electrical Division, write today for Catalog No. 49-A.

**McGILL MANUFACTURING COMPANY, INC.**
**450 N. Campbell St., Valparaiso, Indiana**

# Rigid testing of *Explosion-Proof* CONDULETS® *assures safety and long dependable service*

## Crouse-Hinds extensive laboratories and modern manufacturing combine to give you top quality

Laboratory testing is one of the key operations in the production of electrical equipment of the highest quality. Crouse-Hinds laboratories are equipped with the latest scientific instruments and staffed with expert technicians.

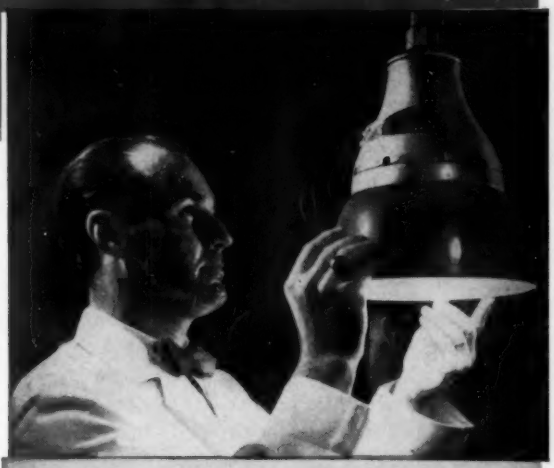
Products are constantly tested to make sure that they are being made to withstand field conditions. New devices are tested to predetermine their meeting or surpassing the requirements of Underwriters' Laboratories.

The photographs at the right show three of the many testing operations that are done in the Electrical Laboratory. It is equipped with apparatus for making both alternating and direct current tests, heat tests, pressure tests and many others.

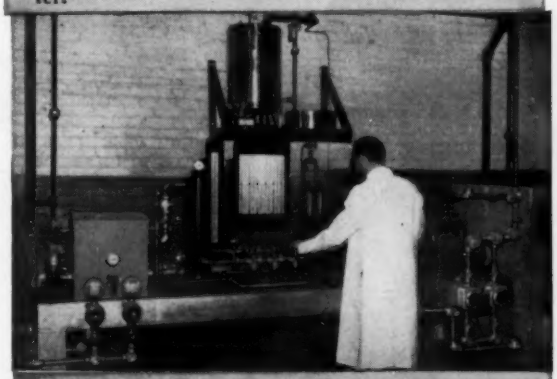
Close cooperation between Crouse-Hinds laboratories and manufacturing departments is one of the reasons why Condulets have been the "Standard of Quality" for nearly fifty years.

Specify CONDULETS on every job. They're made right... to serve you better... and last longer.

**When quality counts**
**... you can count on Condulets**



Probing for maximum exterior operating temperature on a Type EVA Explosion-Proof Lighting Fixture using a multiple point recording potentiometer.



Adjusting carburetors and flow meters to create a predetermined explosive mixture within an explosion-proof Condulet for an explosion test.

Photographing the pressure wave in the Oscilloscope to determine the maximum explosion pressure within an explosion-proof Condulet that is behind the concrete wall.

**CROUSE-HINDS COMPANY**
Syracuse 1, N. Y.

OFFICES: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — New Orleans — New York — Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — St. Paul — Tulsa — Washington. RESIDENT REPRESENTATIVES: Albany — Atlanta — Baltimore — Charlotte — Corpus Christi — Reading, Pa. — Richmond, Va. — Shreveport
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

CONDULET — First in the field — STANDARD OF QUALITY

*CONDULETS are made only by CROUSE-HINDS

A Nationwide Distribution Through Electrical Distributors

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

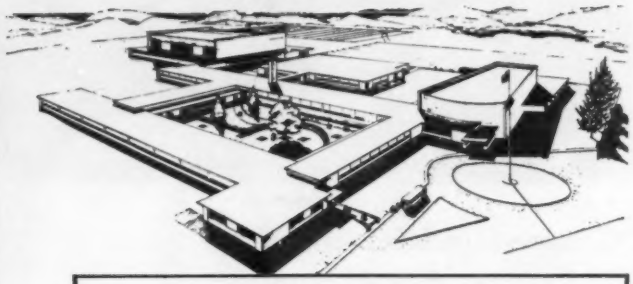
# MITCHELL Lighting chosen

## for the Monroeville Junior High School

WALTER E. SCHARDT, Registered Architect

With many years experience in the highly specialized field of school architecture, Mr. Schardt has numerous problems confronting him relative to the overall well-being of students, faculty and the community in general.

"While there are many requirements to be considered in school design," Mr. Schardt states, "I place the utmost emphasis on classroom lighting. In specifying Mitchell lighting I am mindful that for many years, this brand has stood for practical design, high efficiency and simplicity of maintenance at reasonable cost."

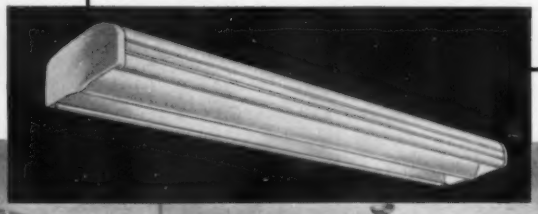


**MITCHELL LIGHTS ANOTHER SCHOOL**

**Monroeville Jr. High School**
**Monroeville, Pennsylvania**

**Architect:** Walter E. Schardt, R. A., Pittsburgh
**Electrical Contractor:** Reno Electric Co., Ambridge, Pa.
**Distributor:** Westinghouse Electric Supply Co., Pittsburgh

**INSTALLATION:** Over 500 MITCHELL "Low Brightness" Luminaires, suspension-mounted throughout, both louvered and unlouvered, delivering an average of 38 footcandles maintained.

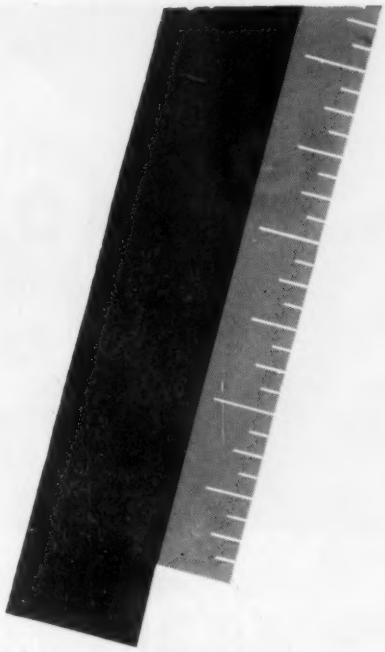


*for better school lighting,*
***SPECIFY MITCHELL***

Write for complete details on MITCHELL School and Commercial Lighting

**MITCHELL MANUFACTURING COMPANY**
**2525 N. Clybourn Ave., Chicago 14, Ill., Dept. 2-C**
**In Canada:** Mitchell Mfg. Co., Ltd., 19 Waterman Ave., Toronto

# guaranteed footage ... *plus*



You get full measure with every roll of Jenkins Gold Seal Tape.

But what's even more important, every inch measures up to the Gold Seal standard, which makes every roll go further. It has lasting "tack" in any weather.

A few neat wraps and the job's finished . . . one thickness insulates. Get the most "coverage" per roll . . . specify Gold Seal.

Jenkins Bros. (Rubber Division),
100 Park Ave., New York 17.


**JENKINS**
**GOLD SEAL TAPE**
**FOR EVERY JOB**


Available in 10-roll cartons or single rolls. Every roll cellophane protected to stay factory-fresh.

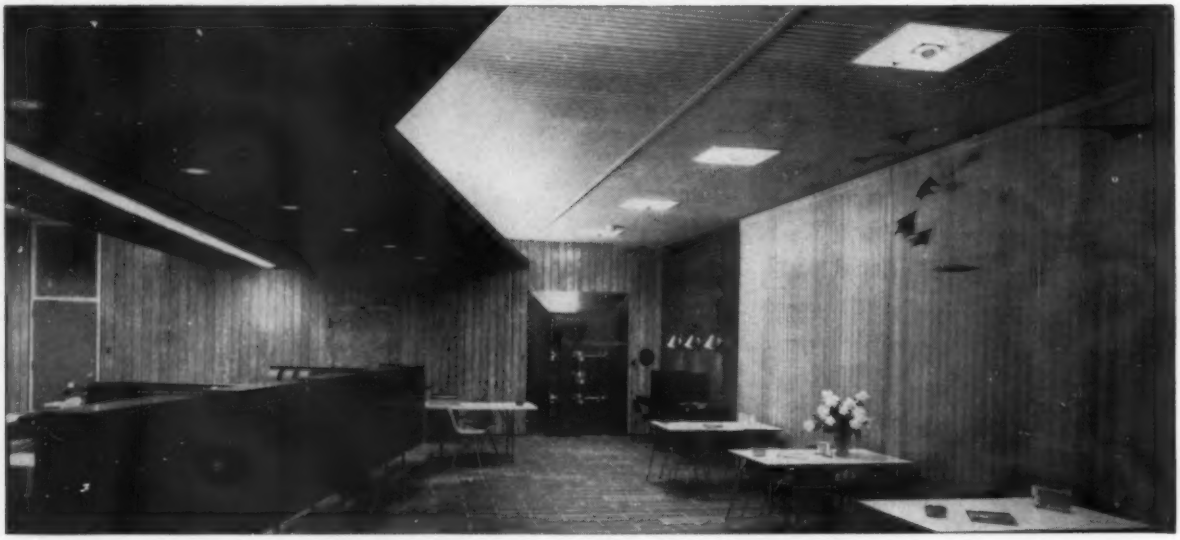
**JENKINS**

*Gold Seal Tape*

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM Specifications.

A PRODUCT OF JENKINS BROS....

MAKERS OF FAMOUS JENKINS VALVES



*Public area in the First Federal Savings and Loan Co., Conover, N. C. Clemmer, Horton & Rudisell, architects, Robert Bush, consulting engineer.*

## A COMBINATION OF *Skylike* AND *Silver-dot* FOR THE ULTIMATE IN . . .

*A view behind the tellers' counters with Silver-dot units over them and Skylike units over the general work area.*

*The general work area behind the tellers' counters. Skylike unit recessed in a Reynolds Corrugated and Perforated Aluminum ceiling.*

# LIGHTING INSTALLATIONS

Three essential factors of lighting installations are PERFORMANCE, ECONOMY, EFFECTIVENESS, and this combination of Skylike and Silver-dot units provides those essentials to their highest degree.

The even distribution of Skylike units provide glareless light over the public areas for "comfortable seeing" (top illustration). The work areas (shown on the left) have Silver-dot unit over the tellers' desks for the accent and supplementary lighting required, and Skylike units over the general work area for "easy-to-work-with" lighting.

This combination is a complete installation—that proves its effectiveness by its beauty, its economy by low initial cost, lowest current consumption and easy maintenance, and its performance by the lighting comfort it provides to workers and customers.

Here, indeed, is a typical example of Skylike installations in which functional light also becomes an integral part of architectural design.

OFFICE
RKO BUILDING
Radio City, N. Y.

**SKYLIKE LIGHTING, INC.**
A SILVRAY ASSOCIATED COMPANY

FACTORY
BOUND BROOK
New Jersey

# No more on-the-job thread rusting worries

## with EXCLUSIVE PITTSBURGH STANDARD GALVANIZED THREADS ON HOT-DIP GALVANIZED CONDUIT


Here's the development which has meant a revolutionary step forward to contractors and plant engineers—Pittsburgh Standard's exclusive new process of galvanizing threads on hot-dip galvanized conduit. Threads stay bright, clean, rust-free!

With no rusting in storage or on the job, and no more expensive thread chasing, hours and dollars are saved. No wonder the men who use hot-dip galvanized conduit are switching to Pittsburgh Standard—here's a bonus from our extraordinary new *Morrisville plant which dramatically shows why Pittsburgh Standard is the "Standard of the Trade."

Why not try it, and see for yourself?

*Famous "Standard of the Trade" Products*

RIGID STEEL CONDUIT
All Finishes

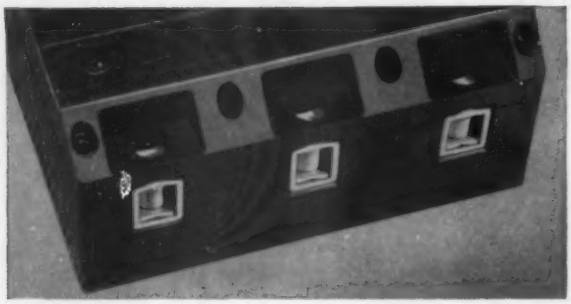
ELECTRICAL METALLIC TUBING
ELBOWS • COUPLINGS • FITTINGS

**Galvanized threads on all sizes from the Morrisville plant, and on sizes 2-in. and larger from the Etna plant.*

PLANTS AT MORRISVILLE & ETNA, PA.

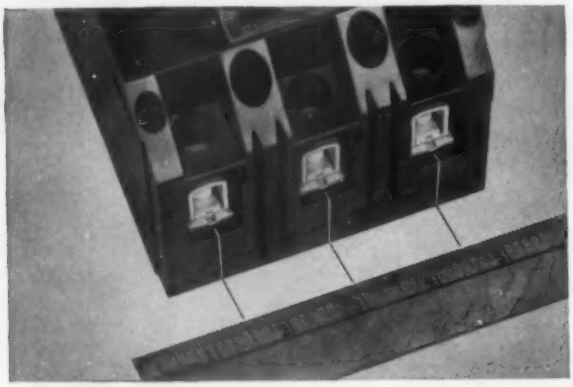
*WHOLESALERS IN PRINCIPAL CITIES*

# I-T-E Molded Case Circuit Breakers Offer You These Extra Values



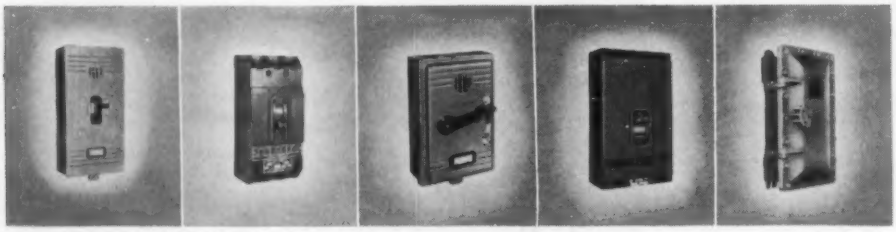
**1. Enclosed terminals.** Provide maximum safety to personnel, yet permit ease of cable connection. All 600 v a-c rated I-T-E molded case breakers have enclosed line and load terminals.

**2. External instantaneous trip adjustment.** Accessible from front of breaker. Adjustment can be changed to desired setting after breaker is installed without removing cover or disrupting service.



**3. Greater terminal clearance.** I-T-E molded case breakers are designed on multiple 1½″ pole centers to provide maximum phase to phase spacings and reduce electrical leakage clearance problems.

**4. Plug in mounting.** I-T-E molded case breakers can be readily equipped with tulip clip adaptors and molded mounting block for maximum flexibility when changing and installing breakers.



**5. A complete line.** I-T-E manufactures a complete line of commercial, Navy and maritime molded case circuit breakers 10 through 600 amp, 600 v a-c, 250 v d-c. All are available with various special features and in all types of individual enclosures.

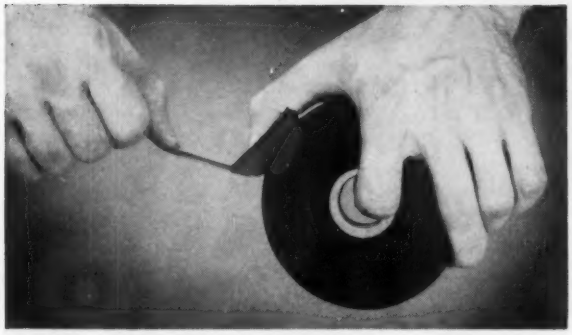
Contact your I-T-E representative or authorized distributor for the Speedfax Catalog—containing complete information on all I-T-E circuit breakers and enclosures. Or, if more convenient, write Small Air Circuit Breaker Division, I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pa.

**I-T-E CIRCUIT BREAKER COMPANY**

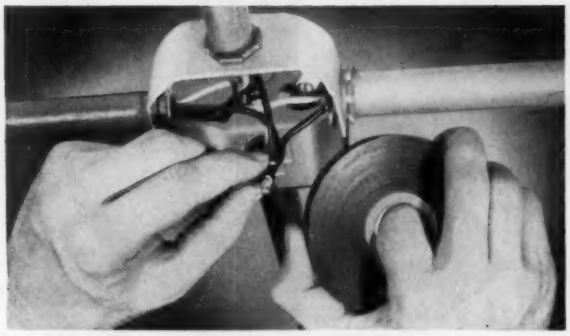
**Small Air Circuit Breaker Division**

# Whatever the job . . .

# PERMACEL TAPE

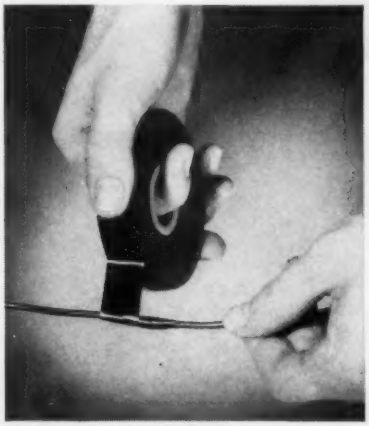


**PLASTIC CUTTER BAR** free with every 66′ roll of Permacel 29 Plastic Tape. It does away with scissors, knives and razor blades. A non-conductor. Durable and easy to use. It cuts waste, saves time.



**PERMACEL 29** will stretch to over twice its original length, permitting it to mold snugly to the work. The result is a tight, smooth wrap for splices in junction boxes and general wiring applications.

**ONE WRAP** does the job on television antennas. Permacel 29 resists weather . . . sticks tight. Requires less tape per job.



**NEAT, THIN SPLICES** with Permacel 29 Plastic Tape. Dielectric strength of 9,000 volts. Resists moisture, oil and abrasion.

**INSULATING TOOLS** is just one of a wide variety of general, electrical and automotive uses of Permacel 29 Plastic Tape.

SELF-STICKING

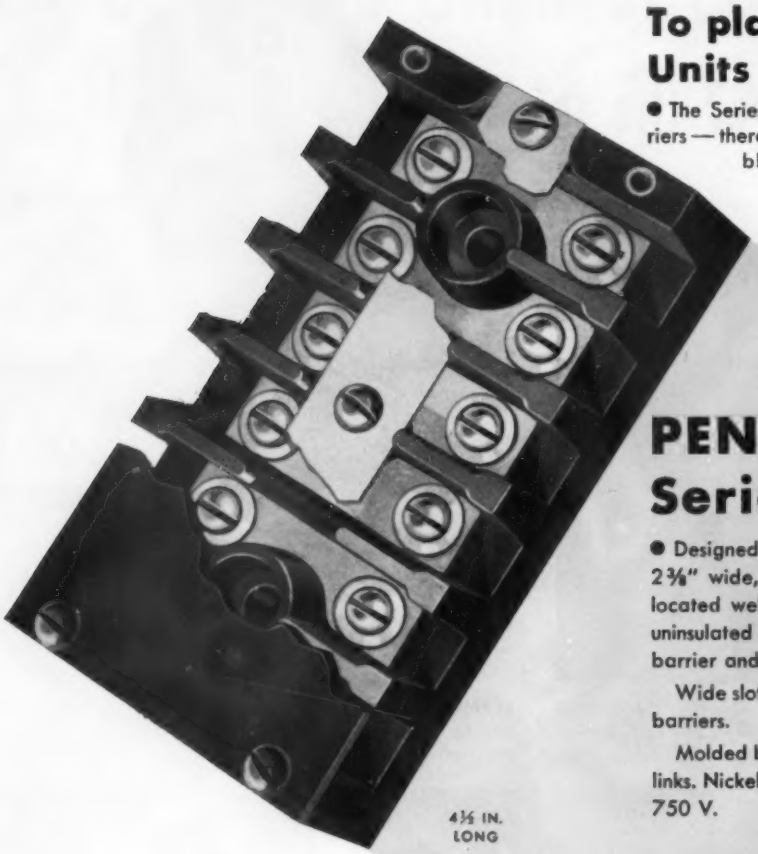
# PERMACEL® TAPES

*Many jobs can be done faster, better, easier with self-sticking tape . . . write Permacel Tape Corporation, New Brunswick, N. J.*

a Johnson & Johnson company

## To place More Units *Lengthwise*

● The Series 1000 has no extra-width end barriers — there are no wide gaps between adjacent block connections, so more units go lengthwise in the space available.



4½ IN. LONG

# PENN-UNION Series 1000

● Designed for space-economy lengthwise — but 2⅜" wide, permitting the binding screws to be located well away from the sides; less chance of uninsulated ends of wires projecting beyond the barrier and causing shorts.

Wide slot for making connections — ½" between barriers.

Molded black Bakelite base. Hard rolled copper links. Nickel-plated brass screws. Rating, 30 amp., 750 V.

3⅜ IN. LONG

## Popular Block for Appliances— PENN-UNION Series 3300

● Widely used for Electric Dryers, Washing Machines, Ranges, etc. Substantially made, fully up to standard Penn-Union specifications 60 Amp., 250 V.

2½ IN. LONG

## Small 4-wire for Appliances— PENN-UNION Series 5000

● A compact miniature of Series 1000, only ⅞-inch high and 1⅛-inch wide, rated 20 Amp., 500 V.

# PENN-UNION Terminal

## To place More Units *Sidewise*

● Nickel-plated brass screws and hard rolled copper links, standard on Penn-Union Terminal Blocks.

5⅛ IN. LONG

# PENN-UNION Series 6000

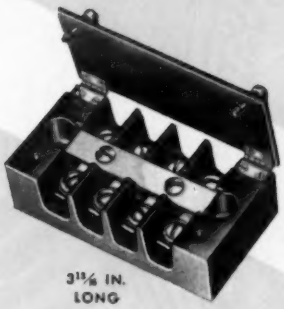
● Same wide slot as Series 1000, but 16% narrower—especially suitable when soldered or solderless lugs are to be used on the lead wires.

30 Amp., 750 V. The short-time current ratings can be increased by using additional jumper bars and longer screws.

Material specifications are same as Series 1000.



● Accurate alignment is assured by molding the brass inserts in the block, and tapping after molding.



3¹³⁄₁₆ IN. LONG

## COVERS

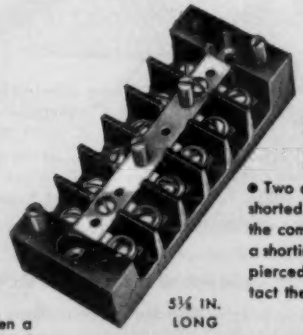
● Bakelite or Asbestos — Hinged if desired.

Holes are tapped at the corners of Penn-Union Series 6000 Blocks, for attaching a Bakelite or Ebony Asbestos cover, which can be furnished. 4 screws, or hinges with fastening knurled-head captive screws, or by spring clips for instant access.

5⅛ IN. LONG

## Multiple Circuit Jumper Bars

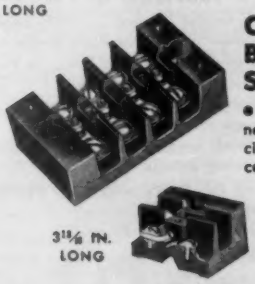
● To give any required branch circuits and tap-offs. Heavy rolled copper bar, in 12-circuit length, is cut to the circuits needed. At the right is shown one of the innumerable combinations that can be made.



5⅛ IN. LONG

## Short Circuiting Series 6000—SC

● Two or more of the circuits can be shorted whenever desired. In place of the composition marking strip, there's a shorting strip of hard rolled copper, pierced to take shorting pins to contact the jumper bar.



3¹³⁄₁₆ IN. LONG

## Circuit Breaking Series 6000—CB

● Very convenient when it's necessary to open and close circuits easily — for instance when a complex circuit must be sectionalized to locate trouble or make an adjustment.

The circuit-closing screws have machined shoulders—so that when in the open position they can't be turned and closed by vibration.

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*Average determined by comparison with conventional control cable.

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Use smaller conduit and fittings or put more conductors in existing conduit.
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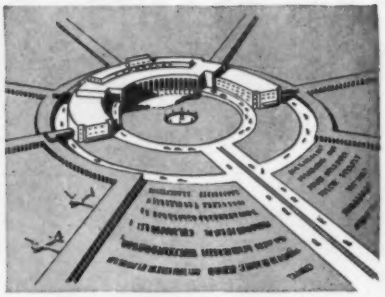

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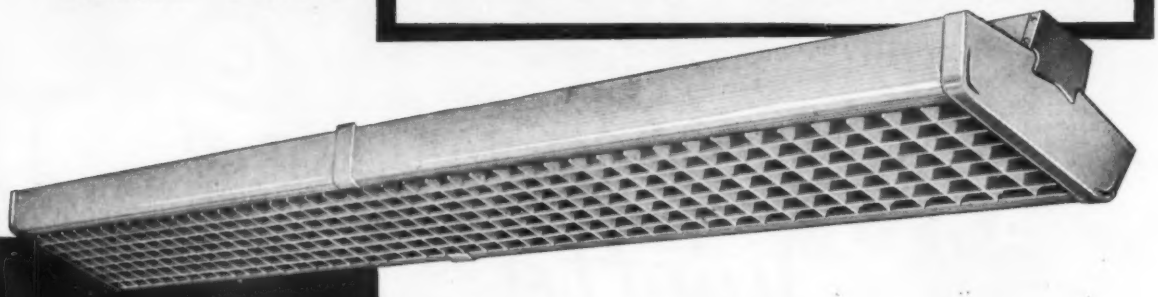

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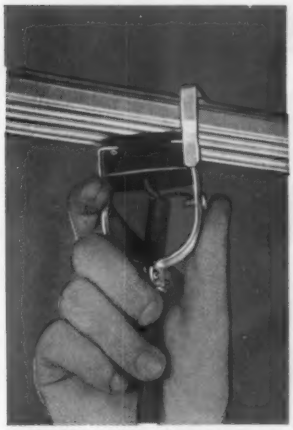

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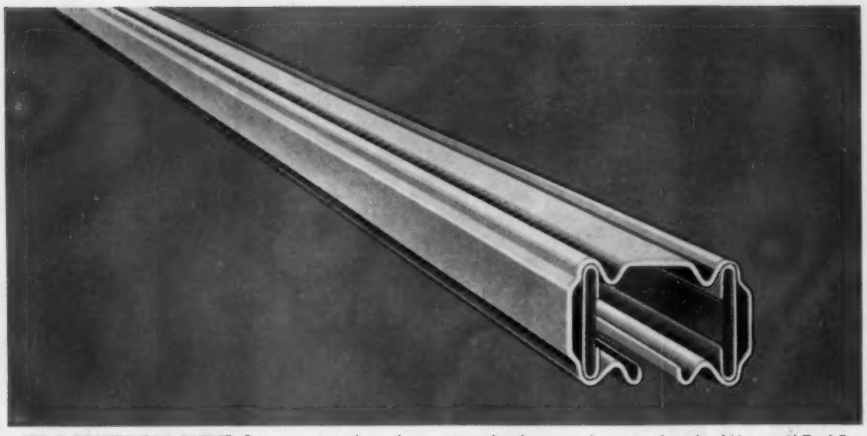

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

54th Year—MARCH • 1955

# Count the Circuits

**Much of the expensive quality** of a well-designed home wiring system is hidden and so technical as to be apparent only on detailed inspection by an expert. Consequently system quality is too often expendable under the pressure of price.

**Physical aspects of wiring,** like plug receptacles and switches, disclose very little about the system. A receptacle looks the same whether it is individually served with a full capacity circuit or whether it is only one of a string of 15 all served by the same circuit.

**Fixtures and built-in lighting** are a better clue to quality but even a good lighting job can be connected to a bare minimum system. Good switching practice also denotes superior design but tells little about the system capacity.

**Available capacity** is directly related to the number of circuits. The number of panel circuits, therefore, is a handy and readily accessible measure of the design quality of the system and its potential use-value to the user. While this very simple, direct and easy way of appraising design capacity is well known in the electrical industry, there has been little effort to use it to sell better wiring.

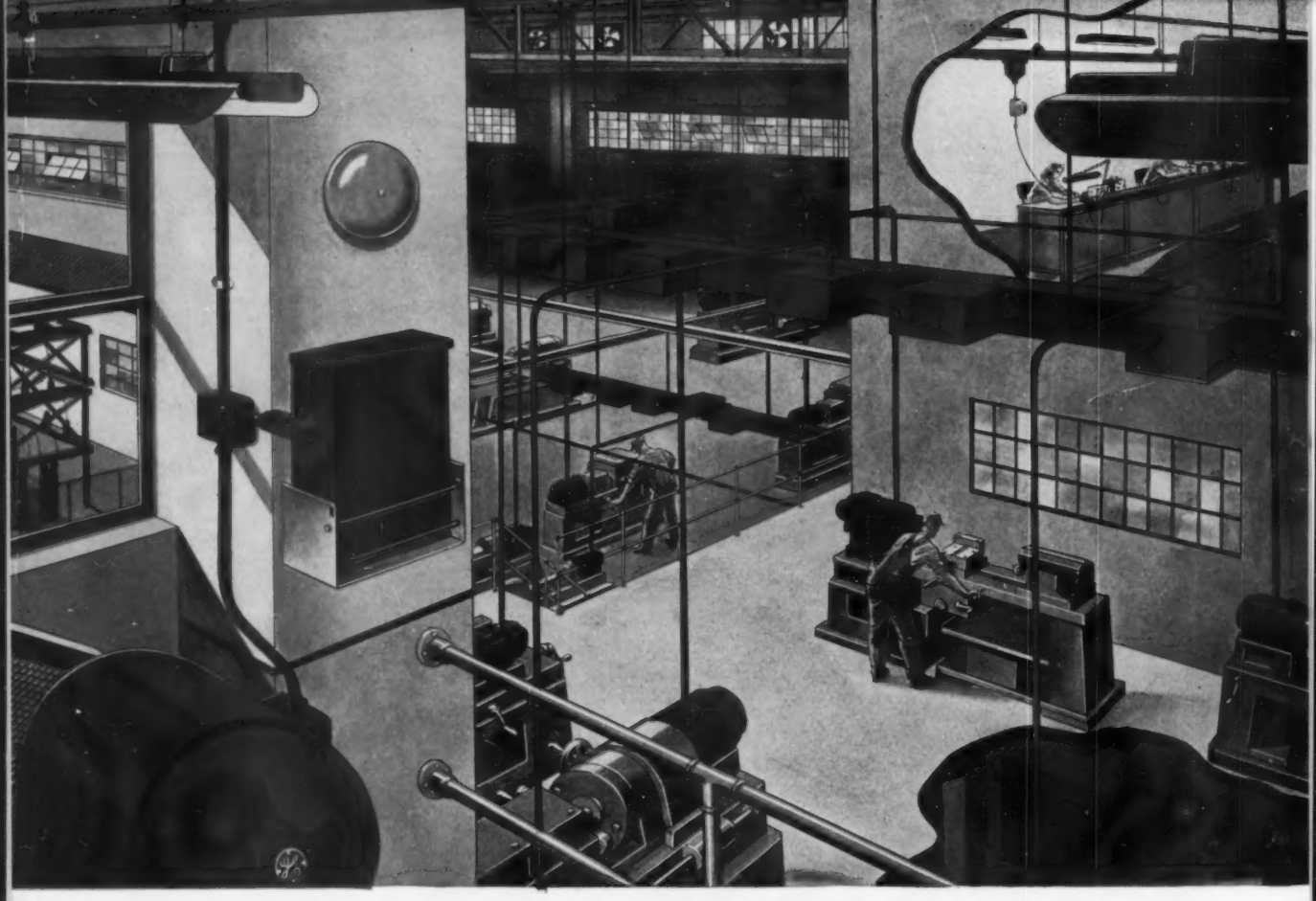
**Traditional practice** is to locate the distribution panel "out of the way" in some inconspicuous location like the basement or garage, usually with the service entrance box. In so doing we play down an important and marketable "feature" of modern high-capacity wiring.

**People are becoming** more conscious of the importance of adequate wiring. Electric power is an accepted "good". Appliances, lights and gadgets are aggressively electric and points of pride to the owner. Then why hide the power center? Modern residential panels are flush, compact and attractive. They may be installed conspicuously and conveniently at load centers in living areas as utilitarian, attractive and objective devices frankly disclosing the quality and capacity of the modern wiring systems they serve.

**It doesn't take an expert** to count the circuits in a panel. Many circuits are obviously "better" than few. Two panels are "better" than one. The proper selection and location of panels of appropriate finish and appearance provide clear identification of the high-capacity electric system.

**Industry standards** strongly recommend the use of residential load center panels. The number of circuits is an easily identifiable characteristic of merit. Attractive, inexpensive equipment acceptable for installation in modern living areas is widely available. We can break the bottleneck of circuit starvation by making panels a conspicuous feature of modern residential electric system design.

Wm. T. Stuart



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ELECTRICAL CONSTRUCTION AND MAINTENANCE

*How to plan . . .*

# FUNCTIONAL RESIDENTIAL ELECTRIC SYSTEMS

**A guide to planning high-capacity home wiring systems with special reference to modern built-in kitchen appliances, load-center distribution and unit air conditioning.**

THE residential electrical system must provide convenient, safe and carefree operation of many home services, appliances and aids. Equipments and devices which require electricity in varying quantities are multiplying at an unprecedented rate. The system which must serve them is, inherently, static. It cannot, of itself, expand to accommodate growing loads. Therefore it must be designed to accommodate the maximum probable requirements which it may have to serve.

Functional wiring design anticipates the various types of loads which the system may be required to serve and provides for them in the original wiring system. Wiring installed in accordance with the recommendations of the Residential Wiring Handbook and the programs of local Adequate Wiring Bureaus are essentially functional systems.

To provide "convenient, safe and carefree operation" requires that the following criteria be considered in the wiring design and layout of the electrical systems.

### *System Characteristics of Merit*

Accessibility—Outlets for utilization must be numerous and located where they are most convenient and useful for the purposes they serve.

Capacity—All parts of the system must be capable of supplying rated utilization voltage under full load. No probable connection or use of normal devices should cause an overload on any part of the system.

Isolation—Refrigeration, home heating plants and other unattended automatic equipment should be serviced by circuits separate from those serving general purpose or portable appliance loads.

Safety—The system must be safe and secure and present no hazards to the user or the home.

Control—The electrical system must provide maximum operating convenience for all normal conditions.

### *Accessibility*

The accessibility of the wiring system is determined by the number and location of outlets for utilization. It should be possible to plug in and use any portable lamp or appliance wherever such devices would be normally used without extension cords.

The Residential Wiring Handbook calls for convenience outlets spaced so that no point along the floor line in any usable wall space is more than 6 feet from an outlet in that space. For kitchens, at least one outlet should be provided for each 4 feet of work-surface frontage with at least one outlet for each work surface. Special purpose outlets should, of course, be placed at the location of the appliance to be served.

While accessibility is usually considered separately from capacity they are inherently related. The full circuit capacity is theoretically "available" at any outlet on the circuit. However, in practical use, when one or more outlets on the circuit are loaded to a substantial fraction of the circuit capacity the accessibility provided by other outlets is effectively disabled. Thus while accessibility is an important characteristic of the system, it must be supported by ample circuit capacity.

### *Circuit Capacity*

Circuit capacity is the key to safe and carefree operation. With an ample number of circuits, properly distributed, the probability of overloading under any condition of normal utilization can be practically eliminated. Circuit capacity is the most abused char-

*Electrical Construction and Maintenance*

# LOAD and CIRCUIT CHART for RESIDENTIAL ELECTRICAL SYSTEMS

| | Typical Connected Watts | Preferred Circuit | Volts | Wires | Circuit Breaker or Fuse | Outlets on Circuit | Outlet | Notes |
|---|---|---|---|---|---|---|---|---|
| **KITCHEN** | | | | | | | | |
| **RANGE** | 12000 | 10 KW. | 120/240 | 3 #6 | 50A. | 1 | Special Purpose | Use of more than one outlet is not recommended. |
| **OVEN (Built in)** | 4500 | 6 KW. | 120/240 | 3 #10 | 30A. | 1 | Special Purpose | May be direct connected. |
| **RANGE TOP** | 6000 | 6 KW. | 120/240 | 3 #10 | 30A. | 1 | Special Purpose | May be direct connected. |
| **RANGE TOP** | 3300 | 4 KW. | 120/240 | 3 #12 | 20A. | 1 | Special Purpose | May be direct connected. |
| **DISHWASHER** | 1200 | 2 KW. | 120 | 2 #12 | 20A. | 1 | Parallel Grounding | These appliances may be direct connected on a single circuit. Grounded receptacles required, otherwise. |
| **WASTE DISPOSER** | 300 | 2 KW. | 120 | 2 #12 | 20A. | 1 | Parallel Grounding | These appliances may be direct connected on a single circuit. Grounded receptacles required, otherwise. |
| **BROILER** | 1500 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding Parallel | Heavy duty appliances regularly used at one location should have a separate circuit. Only one such unit should be attached to a single circuit at the same time. |
| **FRYER** | 1300 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding Parallel | Heavy duty appliances regularly used at one location should have a separate circuit. Only one such unit should be attached to a single circuit at the same time. |
| **COFFEEMAKER** | 1000 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding Parallel | Heavy duty appliances regularly used at one location should have a separate circuit. Only one such unit should be attached to a single circuit at the same time. |
| **REFRIGERATOR** | 300 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding Parallel | Separate circuit serving only refrigerator and freezer is recommended. |
| **FREEZER** | 350 | 2 KW | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding Parallel | Separate circuit serving only refrigerator and freezer is recommended. |
| **LAUNDRY** | | | | | | | | |
| **WASHING MACHINE** | 1200 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding | Grounding type receptacle required. Separate circuit is recommended. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **MACHINE** | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **DRYER** | 5000 | 6 KW. | 120/240 | 3 #10 | 30A. | 1 | Special Purpose | Appliance may be direct connected — must be grounded. |
| **IRONER** | 1650 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding | |
| **HAND IRON** | 1000 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel | Consider possible use in other locations. |
| **WATER HEATER** | 3000 | | | | | | Special Purpose | Consult utility company for load requirements. |
| **LIVING AREAS** | | | | | | | | |
| **WORKSHOP** | 1500 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding | Separate circuit recommended. |
| **PORTABLE HEATER** | 1300 | 2 KW. | 120 | 2 #12 | 20A. | 1 | Parallel | Should not be connected to circuit serving other heavy duty loads. |
| **TELEVISION** | 300 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel | Should not be connected to circuit serving appliances. |
| **PORTABLE LIGHTING** | 1200 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel | Provide one circuit for each 500 sq. ft. Divided receptacle may be switch controlled. |
| **FIXED UTILITIES** | | | | | | | | |
| **FIXED LIGHTING** | 1200 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | | Provide at least one circuit for each 1200 watts of fixed lighting. |
| **AIR CONDITIONER ¾ hp** | 1200 | 2 KW. | 120 | 2 #12 | 20A. | 1 | Parallel Grounding | Consider 4 kw 3-wire circuits to all window or console type air conditioners. Outlets may then be adapted to individual 120- or 240-volt machines. Connection to general purpose or appliance circuits is not recommended. |
| **AIR CONDITIONER 1½ hp** | 2400 | 4 KW. | 120/240 | 3 #12 | 20A. | 1 | Tandem Grounding | Consider 4 kw 3-wire circuits to all window or console type air conditioners. Outlets may then be adapted to individual 120- or 240-volt machines. Connection to general purpose or appliance circuits is not recommended. |
| **CENTRAL AIR CONDITIONER** | 5000 | 6 KW. | 120/240 | | | | Special Purpose | Consult manufacturer for recommended connections. |
| **SUMP PUMP** | 300 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding | May be direct connected. |
| **HEATING PLANT** | 600 | 2 KW. | 120 | 2 #12 | 20A. | 1 | | Direct connected. Some local codes require separate circuit. |
| **FIXED BATH-ROOM HEATER** | 1500 | 2 KW. | 120 | 2 #12 | 20A. | 1 | | Direct connected. |
| **ATTIC FAN** | 300 | 2 KW. | 120 | 2 #12 | 20A. | 1 or more | Parallel Grounding | May be direct connected. Individual circuit is recommended. |

**TABLE I**

**Circuit Schedule for Typical Power Center Serving Built-in Cooking Appliances**

| Load | | Circuit Capacity | | Circuit |
|---|---|---|---|---|
| Built-in oven | Cir. 1-2 | 6 kw | 30-amp | 3-wire No. 10 |
| Range top (2-burner) | Cir. 3-4 | 4 kw | 20-amp | 3-wire No. 12 |
| Range top (2-burner) | Cir. 5-6 | 4 kw | 20-amp | 3-wire No. 12 |
| Receptacles, split (2) | Cir. 7-8 | 4 kw | 20-amp | 3-wire No. 12 |
| Receptacles (2) | Cir. 9 | 2 kw | 20-amp | 2-wire No. 12 |
| Vent fan | | | | |
| Clock outlet | | | | |
| Dishwasher | Cir. 10 | 2 kw | 20-amp | 2-wire No. 12 |
| Disposal unit | | | | |
| Refrigerator | Cir. 11 | 2 kw | 20-amp | 2-wire No. 12 |
| Freezer | | | | |
| Spare | Cir. 12 | 2 kw | ..... | 2-wire ..... |

acteristic of conventional home wiring designs. Yet additional circuit capacity is the least expensive way of building the useful capacity of the system for the user.

The availability of ample circuit capacity is vitally important to good residential electric system design. While the maximum system capacity is limited by the service entrance, an overload on a service is relatively rare. Overloads on branch circuits are so common that many people accept them as a normal and inherent evil of house wiring.

Additional branch circuits, therefore, "open up" the electrical system for full utilization within the service capacity limits. Branch circuits, with proper distribution, are the best "bargain" in residential wiring. Useful system capacity can often be *doubled* for less than 10% of the wiring cost.

### *Isolation*

Special circuits should be installed to serve certain types of automatic equipment which operate unattended. Heating plants, refrigerators, freezers and sump pumps are loads that should not be subject to accidental interruption by faults or overloads in other parts of the system. They should therefore be served by a circuit or circuits to which other equipment cannot be connected.

Other special purpose branch circuits serving a single appliance is always recommended when the appliance is rated at 1 kw or more and is normally used at a fixed location. Automatic clothes washers, dishwashers, ironers, and unit air conditioners are types of equipment which should be served on individual circuits.

In recent years there have been substantial developments in service entrance equipments and residential panelboards, which in turn has greatly influenced wiring system layout. Almost any desired circuit array can be quickly assembled from inexpensive mass-produced components in standardized cabinets. There has been marked improvement in appearance and most residential equipments can be installed flush in the wall.

Such equipments may be installed conspicuously in the kitchen, laundry, utility room or front hall where they are readily accessible and close to the loads which they serve. They need not be and should not be hidden away in the basement, garage or back hallway.

Location of the service entrance equipment is controlled by the meter location, usually an outside corner. If all branch circuits are centered in the service entrance panel home runs must be long. If only the mains and the heavy duty appliance circuits are located at the service entrance, branch circuit distribution panels can be located at load centers permitting short home runs and encouraging the use of full circuit outlets and appliance connections.

From the service entrance equipment feeders may be run to strategically located power-center panels in the kitchen, utility room and front hall.

### *Power Centers*

The Code permits up to six circuits to be served directly from the service entrance conductors. Multiple mains can be conveniently arranged to serve heavy duty appliance circuits, such as the range, dryer and water heater, and feeders to branch circuit distribution panels.

Branch circuit distribution may be incorporated in the service entrance panel enclosure, or in separate panels located at load centers and served by feeders from one or more of the mains.

Typical equipments provide for up to six double-pole fused switches or circuit breakers (or 12 single poles operable by six handles) on a main bus. A separate bus with a group of branch circuits in the same enclosure is fed from one of the mains.

A typical installation, with separate power centers, would provide the following circuits:

50-amp range
30-amp dryer
20-amp water heater
40-amp air conditioner
40-amp kitchen panel
40-amp lighting panel

When power centers are located flush in living areas it is important that provisions be made for access to the spares for future use. A 1-in. empty conduit, tubing or flex is extended to the basement or attic terminating in a 4-11/16-in. box with blank cover.

Electric heating loads are usually served from a separate panel-board fed from one of the mains. The design of the wiring system for electric space heat is governed by the rating and application of the heating equipment. The heating system is a known load and consequently relatively accurate circuit and feeder capacity design is entirely practical. Future capacity may usually be ignored except for unfinished areas likely to be finished or where actual additions to the building are probable.

### *Built-ins*

The rapidly developing trend toward built-in cooking appliances is easily and economically served by kitchen power-center panels. The conventional

range circuit becomes the feeder. Circuits to cooking appliances and other appliance outlets are short and efficient. Since home runs are little longer than runs between outlets, isolating circuits and full circuit outlets can be provided for little more than the cost of the panelboard overcurrent device.

For a typical all-electric kitchen with built-in cooking appliances a standard 12-circuit (12 poles) panel provides a practical power center. The circuit schedule (Table I) arranges cooking appliances on individual circuits, automatic appliances on isolating circuits and appliance outlets on three appliance circuits.

For this typical kitchen panel the demand load may be calculated as follows:

| | | |
|---|---|---|
| Small Portable Appliance Load | 1500 @ 100% | 1500 |
| Appliances (non-cooking) | | |
| Dishwasher | 1200 | |
| Disposal Unit | 300 | |
| Refrigerator | 300 | |
| Freezer | 300 | |
| | 2100 @ 75% | 1575 |
| Cooking Appliances See Table II | | 8150 |
| | | 11225 |

$$11{,}225 \div 230 = 49$$

The feeder demand load therefore is 49 amps which requires three No. 6 conductors.

### *Unit Air Conditioners*

Unit air conditioning is one of the fastest growing residential electrical loads. Unit cooling equipment for window installation have proved to be a highly popular and inexpensive means of providing summer comfort.

Temporary window-sill mounting is rapidly giving way to permanent installation in framed openings designed to take window type units. For homes where no central air conditioning plant is provided or where the heating plant is steam, vapor or hot water the electrical designer must anticipate that the principal living areas and the bedrooms will ultimately be equipped with some form of unit cooling.

A special purpose outlet, located at the most likely point of installation, on a separate No. 12 circuit should be installed in each principal living area and in each bedroom for unit air conditioners.

The use of general purpose or appliance circuits to serve air conditioners is *not* recommended. Even smaller units, though they may be rated within the capacity of such circuits, require a large portion of the circuit capacity under continuous duty over long periods of time. During this time the entire circuit and its other outlets are effectively disabled and inaccessible for other uses for which the circuit is intended, designed and installed.

### *Receptacles for Air Conditioners*

Most unit type air conditioners are connected to the electrical system through a plug and fixed receptacle. Units of ¾-ton capacity or less are usually equipped for operation on 120 volts. Units of 1-ton and larger are usually equipped for operation on 240 volts.

If equipment is supplied by means of metal clad wiring—*or*

If equipment is within reach of a person who can make contact with any grounded object—*or*

If equipment is located within reach of a person standing on the ground—the metal parts of the equipment must be grounded.

Air conditioning units will almost always come under one or more of the above rules and, therefore, should be grounded by an appropriate grounding conductor. Thus the plug and receptacle should be grounding types.

It is also important that 240-volt receptacles be so designed that 120-volt plugs can not be inserted.

Standard receptacles are available to meet the above requirements.

For 120-volt units—15-amp; 125-volt grounding type duplex parallel blade receptacle. This receptacle will accept a conventional parallel cap with two parallel blades and a grounding prong.

For 240-volt units*—15-amp; 250-volt grounding type duplex receptacle with tandem blades (in line). This receptacle will accept a conventional tandem blade cap or a matching 3-pole cap with two tandem blades and a grounding prong. It will not take a parallel blade cap.

The characteristics of unit air conditioners are rarely available when the wiring is planned. The units are usually installed by the owner after the premises are occupied. This requires that the outlets provided for air conditioners in large rooms (living rooms, recreation rooms, etc.) should be adaptable to either supply voltage with a minimum of wiring changes. Since air conditioner outlets are usually served by individual circuits there are practical and inexpensive methods for adapting the circuit to either 120- or 240-volt operation.

A. 2-pole overcurrent device, 3-wire circuit, 120-volt receptacle. The unused conductor is taped. This circuit is changed to higher voltage by replacing the receptacle with a 240-volt type and connecting the appropriate conductor.

B. 2-pole overcurrent device, 2-wire circuit, 120-volt receptacle. This circuit is changed to higher voltage by replacing the receptacle with a 240-volt type and reconnecting at the panel.

C. 1-pole and blank overcurrent device, 2-wire circuit, 120-volt receptacle. This circuit is changed to higher voltage by replacing the receptacle with a 240-volt type, replacing the overcurrent device with a 2-pole type and reconnecting at the panel.

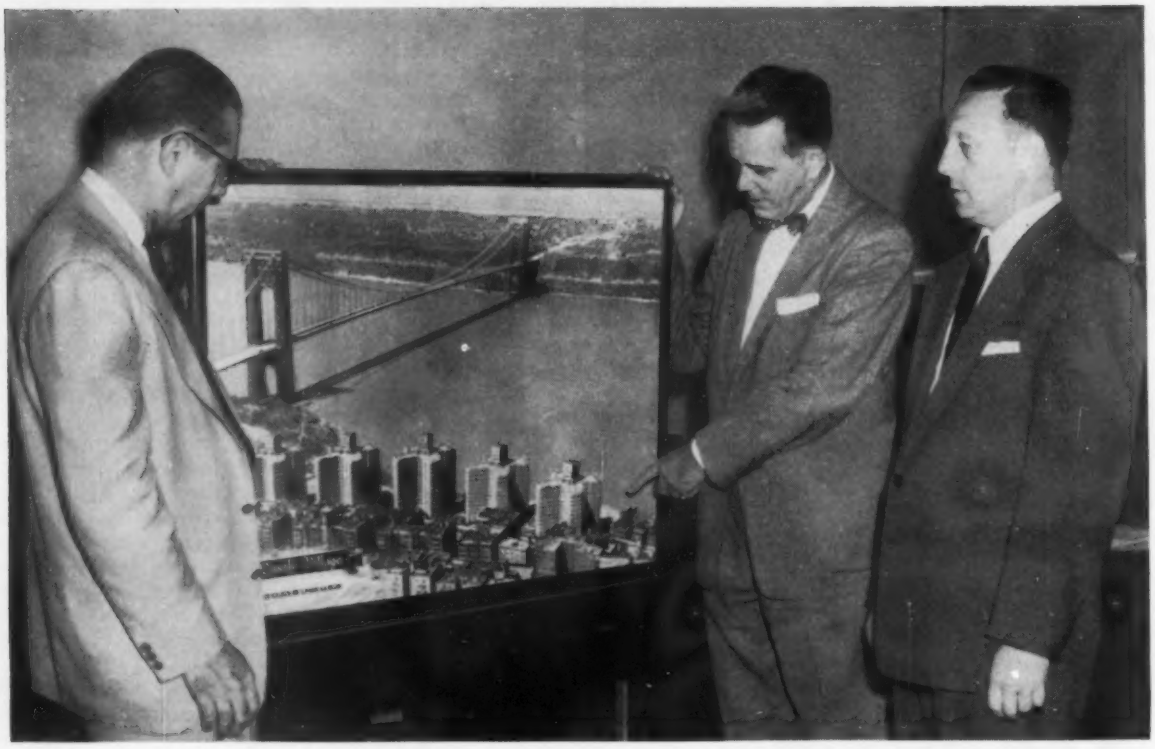
* The tandem blade grounding receptacle is the newer and preferred type for air conditioners. The "crowfoot" receptacle and the twist-lock types are also widely used. Present developments are evidently heading toward adoption of the tandem blade grounding receptacle as standard for 230-volt units.

**TABLE II**

**Calculation of Load for Built-in Cooking Appliances**

**(From N. E. Code Table 29, Demand Loads for Household Electric Appliances and Other Household Cooking Appliances Over 1¾ kw Rating.)**

| | |
|---|---|
| Two 2-Burner Tops, One Oven | |
| Two 2-Burner Range Tops at 330 watts nameplate rating each | |
| 6600 watts at 75% (Col. 3 Table 29) | 4950 |
| 1 Oven at 4000 watts nameplate rating | |
| 4000 watts at 80% (Col. 4 Table 29) | 3200 |
| Total range demand | 8150 |



**WORK PROGRESS** in the rewiring of Castle Village is discussed by John J. Marger (pointing), building manager; Albert I. Pozner (right), electrical contractor; and Leonard H. Gantner, electrical superintendent.

### *CASTLE VILLAGE PROVES*

# Rewiring Can Be Profitable

### *FOR CONTRACTOR AND OWNER*

**Returns from additional electrical capacity for air conditioning and appliance loads pay off loan, increase value of property.**

REWIRING of Castle Village, an apartment project in New York City, is bringing attractive returns on the original investment to building owners. Electrical capacity of these five 13-story buildings is being increased by Pozner Electric Co., New York electrical contractors, to accommodate air conditioning and appliance loads. The tenant, who is profiting through increased convenience, is assuming the cost of the project by a rent increase.

The New York Temporary State Housing Rent Commission has ruled that wiring in a building which is improved for the benefit of the tenants is additional service, justifying a rent increase. The amount of monthly increase is computed by the Commission based on an approximate seven-year amortization of the rewiring cost.

Figures provided by Nehring Bros. Inc., managers of Castle Village, show how this works. The monthly increase includes three charges (see box): (1) the tenant's share of the cost of rewiring, (2) the cost of electricity consumed by the air conditioner (based on costs of a ¾-hp unit, spread evenly over the 12 months of the year), and (3) a flat $2 charge permitted by law when the conditioner projects more than 6 inches beyond the building wall.

While this rent increase affects only tenants choosing to install air conditioning units, the new kitchen appliance circuits are available to all.

**Rent Increase Breakdown**

| | |
|---|---|
| (1) Cost of rewiring..... | $4.00 |
| (2) Cost of electricity... | 2.91 |
| (3) Conditioner overhang. | 2.00 |
| Total monthly increase with one conditioner.. | $8.91 |

Of chief importance to the owner is that, besides the material increase in the value of the property, the principal and interest of the loan for the cost of rewiring can be met if only 20% of the tenants install conditioners. Increases from additional installations mean clear profit on the investment.

# DETAILS OF CONSTRUCTION

Electrical capacity to take care of the air conditioning and appliance loads is being provided at Castle Village with a minimum of disturbance to existing building construction. All new wiring, except for new risers, is being installed in existing conduit. The first of the five buildings to be completed illustrates the construction details Pozner Electric Co. is using on the job.

The existing 1200-amp service switch was replaced by a 2000-amp pressure-operated switch. The old 1200-amp switch was mounted in a new cabinet and used to feed the new air conditioning and appliance circuits (see Fig. 1). Four new risers were installed in the building to be used exclusively for the new circuits. Of the two risers servicing each half of the building, one feeds the lower floors, the other the upper. All new risers are 120/208-volt, 3-phase, 4-conductor, 300MCM RH in 3-inch conduit throughout the run, switched by 400-amp knife switches in a new basement cabinet.

A new branch circuit panel was tapped off the riser at each floor. This panel, incorporating a 100-amp pull-out switch, accommodates 16 circuits (except for first-floor 8-circuit panel), protected by 20-amp screw-base fuses. Each air conditioner and kitchen receptacle circuit is fused here. These panels were installed next to existing floor panels feeding apartment lighting and receptacle circuits.

Fig. 2 shows how existing ½-inch conduit to each apartment carries the new circuits. Since the new and old panels are side by side, it was a simple matter to route the new wiring from the new panel through the old and into the conduit to the apartment. Circuits from the old panel to the apartments had been a pair of No. 12 RH. These were replaced by two No. 12 TW pulled in with four more No. 12 TW (3 live, 1 neutral) from the new panel.

The three live conductors serve two air conditioning circuits and a new kitchen appliance circuit. The old pair of No. 14 RH conductors feeding the kitchen receptacles was removed and the No. 12 TW pulled in.

The two new circuits for air conditioners were installed in the existing ½-inch conduit for the bedroom receptacle circuit. Specifications called for air conditioning circuits in the bedroom and living room of each apartment. In all cases, bedrooms and living rooms shared a common wall, so that it was possible to install the air conditioning receptacles back-to-back, immediately above the existing bedroom receptacles. Where the bedroom receptacle was not reasonably close to a window, the circuit was extended by surface metal molding.

Except for the occasional metal molding and the air conditioning receptacles, none of the new work is visible in any of the apartments. Risers and floor panels are confined to hall closets or maids' lavatories, while all service equipment and switching cabinets are in the basement.

Since these new circuits are entirely independent, the utility has installed a recording watthour-meter at the 1200-amp switch, expecting that the meter, left in place for a year or two, will furnish valuable utilization data on appliance and air conditioning loads.

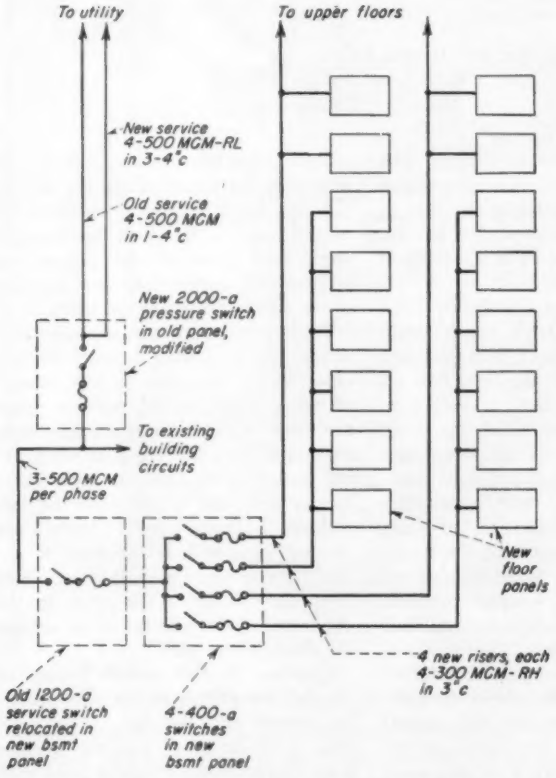



**FIG. 1.** Single-line diagram shows wiring associated with new air conditioning and appliance circuits.

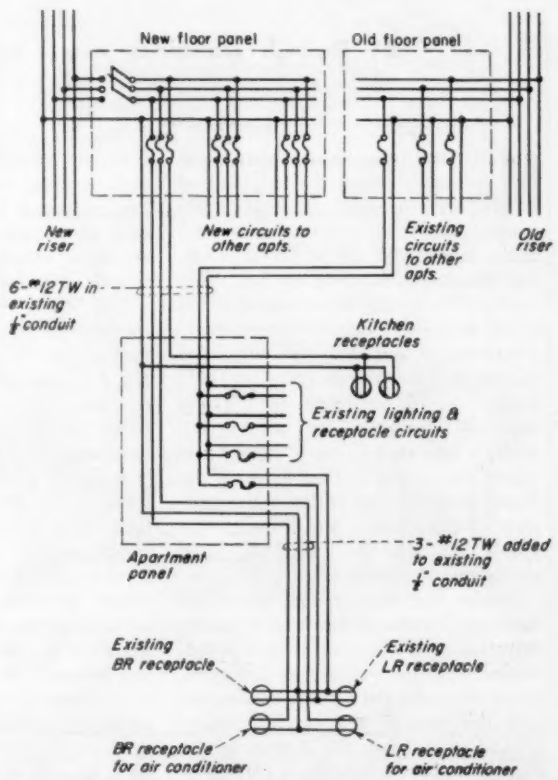



**FIG. 2.** Diagram of typical floor wiring shows how existing conduit is being used for new circuits.

# DISTRIBUTION

**A round up of installation methods used on the pole and underground work for a high tension electrical distribution system serving the large-scale Calliope Street, Housing Project, New Orleans, La. Electrical design was by Louis N. Goodman, consulting electrical engineer, New Orleans.**

**By Dan J. Duvoisin,** *President, Atlas Electric, New Orleans, La.*

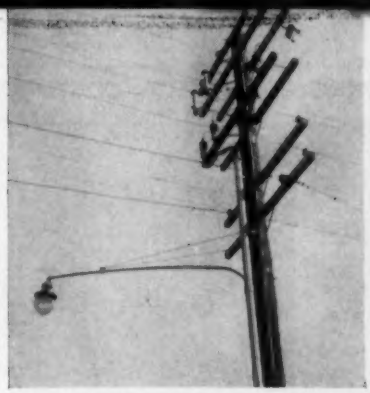
MODERN, engineered installation techniques form the backbone of a high tension, overhead-underground electrical distribution system at the expansive Calliope Street Housing Project, New Orleans, La. This distribution system serves a total of 860 living units—3½, 4½ and 5½ room apartments—in 48 four-story buildings. The project is divided electrically into three groups of 16 buildings, each group supplied from a separate pole in the utility's overhead primary supply line which runs along a street forming the North property line of the entire project. A close look at one of the groups points up the job methods used throughout the project.

Power for the typical group of buildings shown in the layout plan is delivered at 13,200/7620 volts, 3-phase, 4-wire from the utility pole indicated. From this pole, the 3-phase conductors and the neutral are carried underground to pull box No. 1 from which point one phase conductor is carried to the left and another to the right—each underground then up to a pole-mounted transformer as shown. The runs of phase conductors in these cases are continuous from the utility pole to each of the transformers; the neutral conductor carried to each transformer is spliced in the pull box.

The third phase conductor and the neutral are carried continuously through pull box No. 1, into pull box No. 2 and out of it to the right then up to the pole-mounted transformer. From the pothead at which the cable terminates on the crossarm, connection is made to a 7620/120-240-volt transformer. The neutral, which comes up the pole in the conduit with the phase conductor, also connects to the transformer. From this same single-conductor pothead, a jumper connects to another single-conductor pothead alongside the first one. From this second pothead, the third phase conductor is continued down the pole in the same conduit in which it and the neutral came up the pole. The cable is carried back to pull box No. 2 in the same conduit, then out the left side of the pull box and in conduit up to another pole-mounted transformer. The neutral run with the phase conductor to this last pole is spliced to the neutral cable in pull box No. 2. With the arrangement used none of the phases are spliced—all connections to primary phase cables are made on poles.

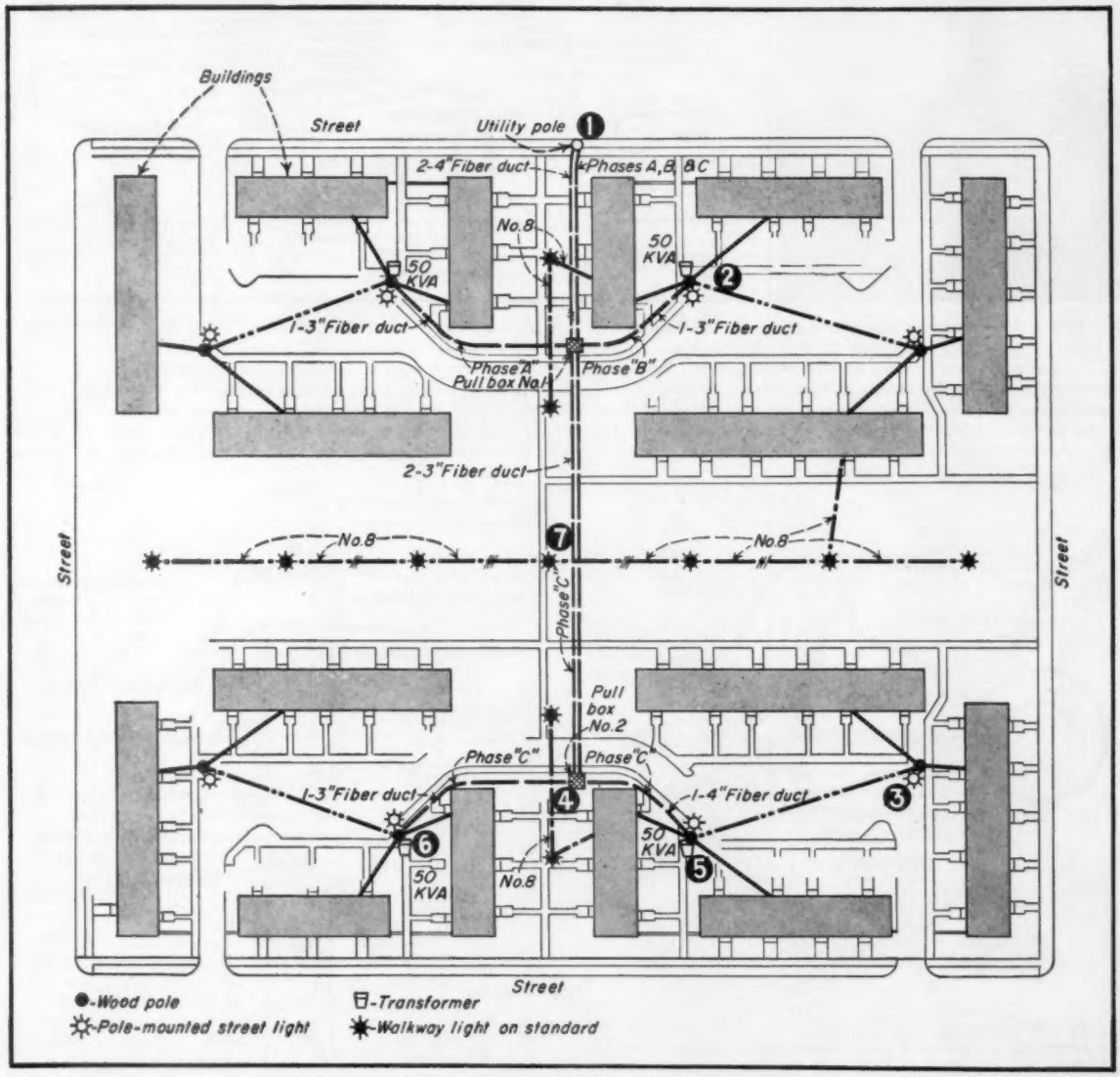
Each of the four transformers is a single phase, 3-wire output, 50 kva unit. From the secondary side of each of these transformers, service drops are made to the two nearest apartment buildings. In addition, a street lighting fixture is mounted on each transformer pole and is tied into the secondary. Secondary aerial feeders are carried from each transformer to another pole across the yard, from which point service drops are made to the other two of the four buildings around the transformer pole.

Closeups of the various phases of the job are shown in the accompanying photos and sketches. Code numbers on the layout plan on the opposite page corespond to numbers used with illustrations, showing details at these points in the system.

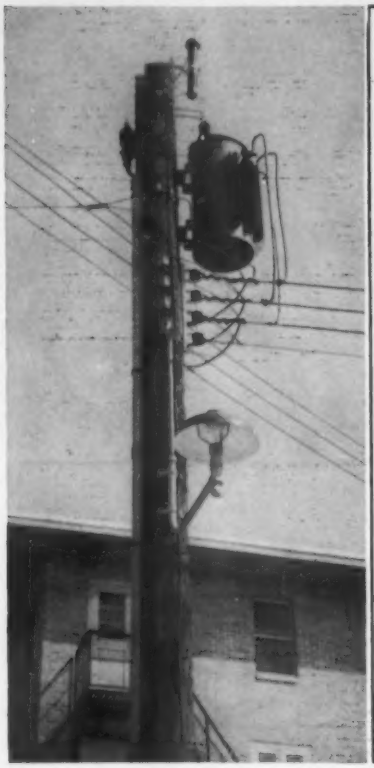


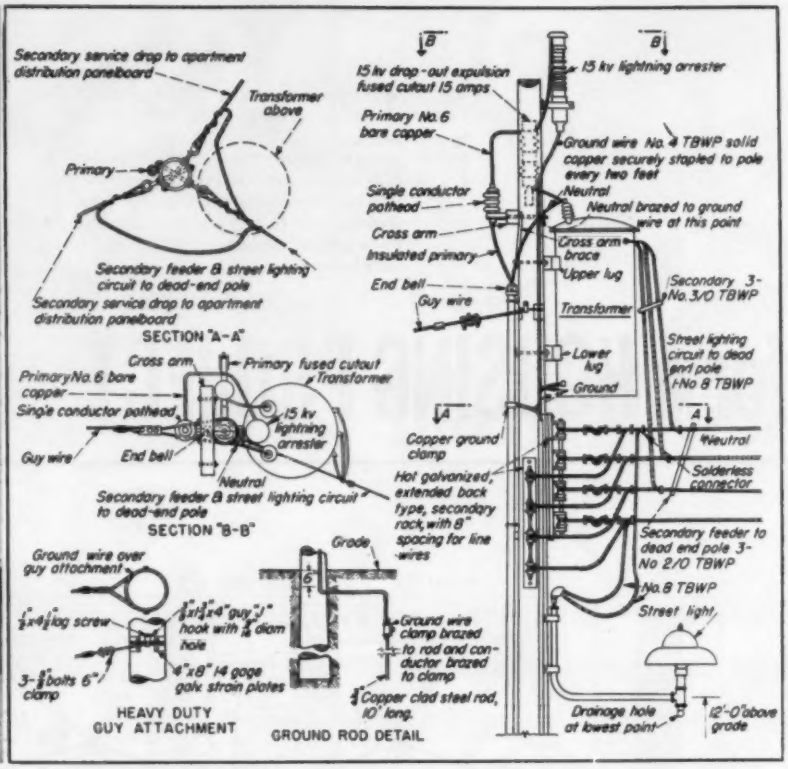
**1.** Incoming service to the group of sixteen buildings is 13,200/7620 volts, 3-phase, 4-wire—three No. 6, 15-kv primary phase cables and one No. 6, 600 volt neutral cable—from utility pole line, in 4-inch conduit, down the pole and underground to pull box No. 1 where the three phases branch out to the stepdown transformers.

# for a HOUSING PROJECT

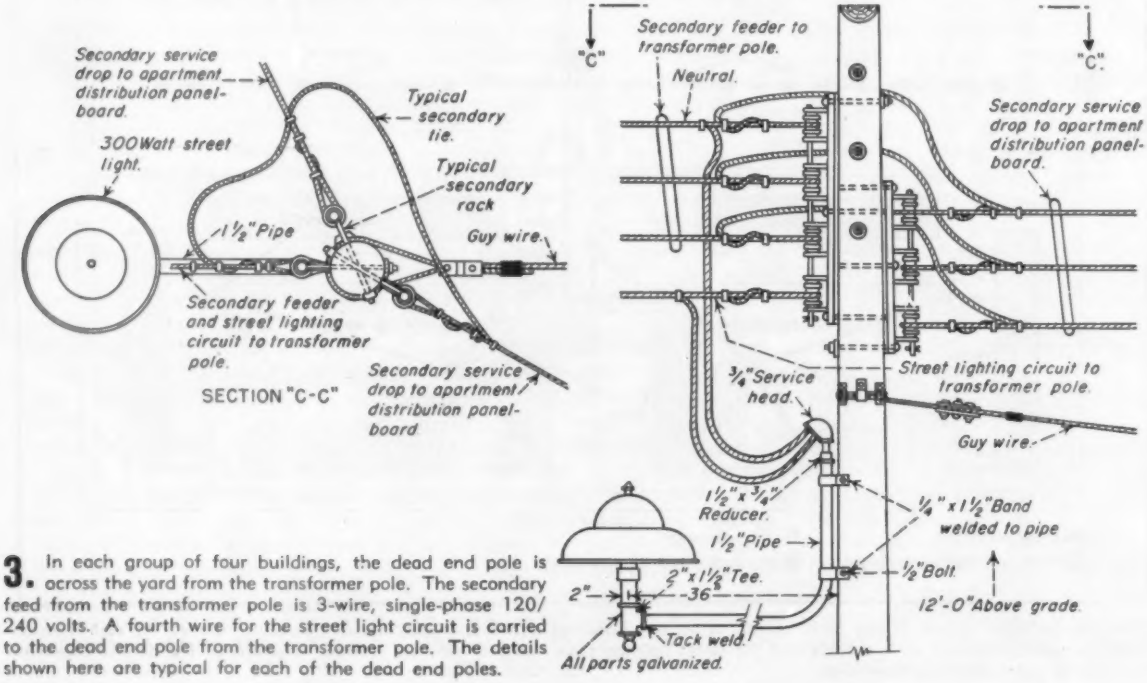



**TYPICAL LAYOUT** of one of the three groups of sixteen buildings shows the locations of poles, the routing of high tension lines, the arrangement of service drops and the street lighting plan. Circled numbers indicate locations of job details shown in illustrations correspondingly numbered.

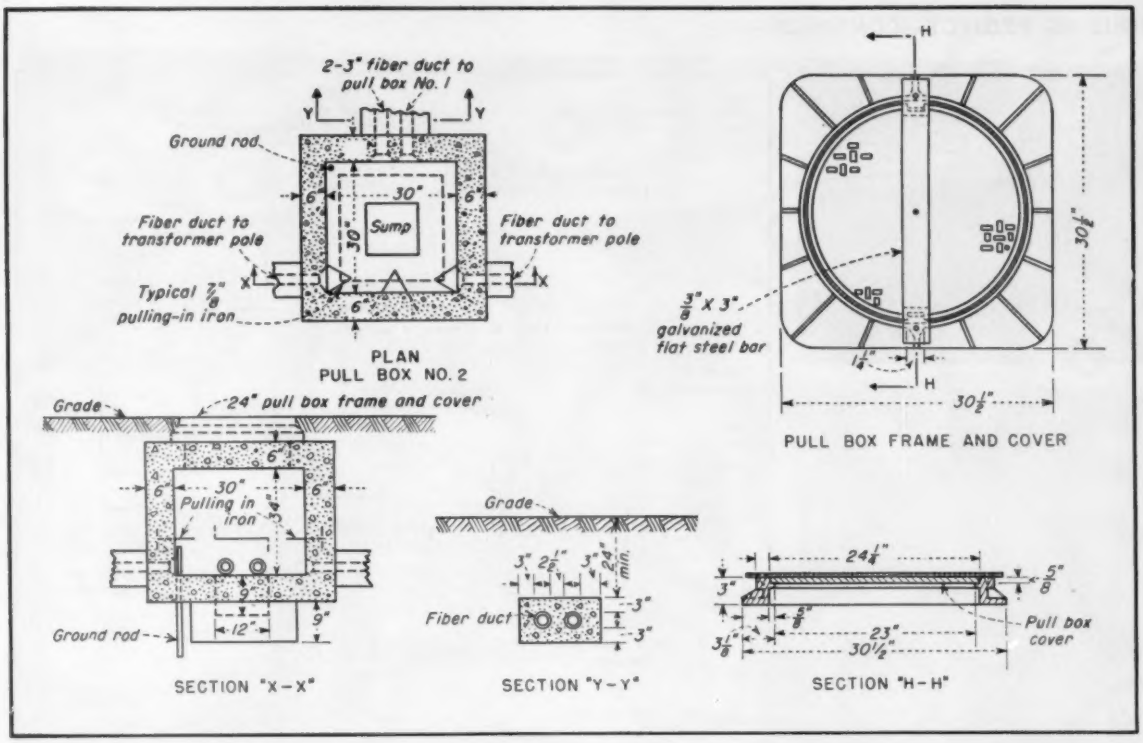




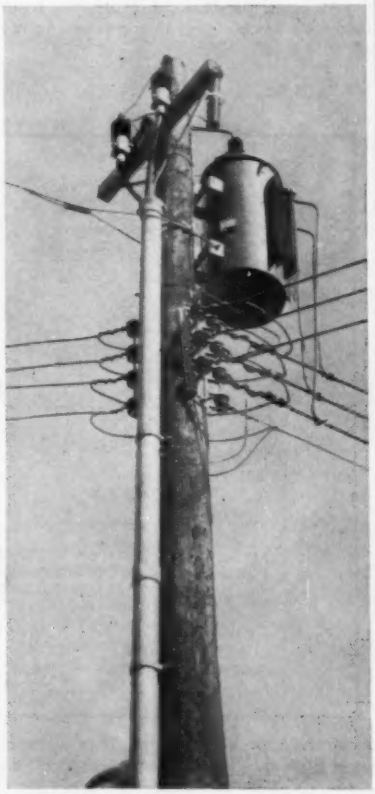

**2.** Phase "B" primary cable and a cable tap off the neutral are carried in a 3-in, concrete-encased fiber duct from pull box No. 1 to a pole mounted, 50-kva, single-phase, 7620/120-240-volt, oil immersed, self-cooled transformer with 2½% taps above and below normal on the primary side. The street lighting fixture houses a 300-watt incandescent lamp. This fixture and the one on the dead end pole across the yard are on circuit fed to the poles from a time switch at the distribution panelboard in one of the buildings. Each of the four groups of four buildings shown has its own transformer pole and dead end pole across the yard. The arrangement of equipment on the transformer pole supplied by phase "A" is identical to that for phase "B". As shown on the plan, phase "C" supplies two transformer poles for the eight buildings furthest from the utility pole.



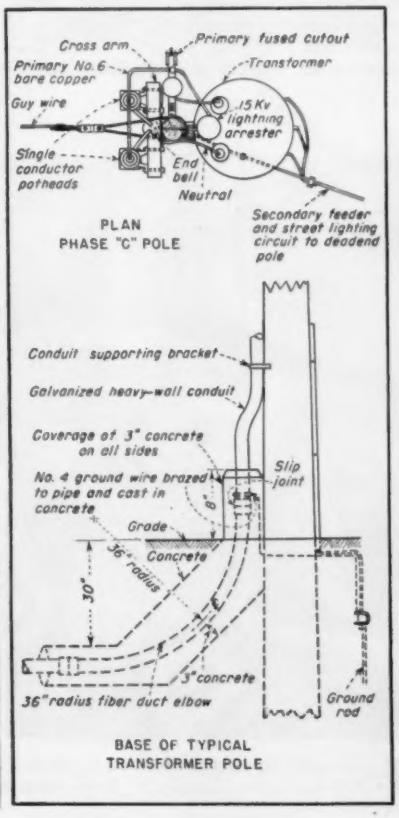

**3.** In each group of four buildings, the dead end pole is across the yard from the transformer pole. The secondary feed from the transformer pole is 3-wire, single-phase 120/240 volts. A fourth wire for the street light circuit is carried to the dead end pole from the transformer pole. The details shown here are typical for each of the dead end poles.

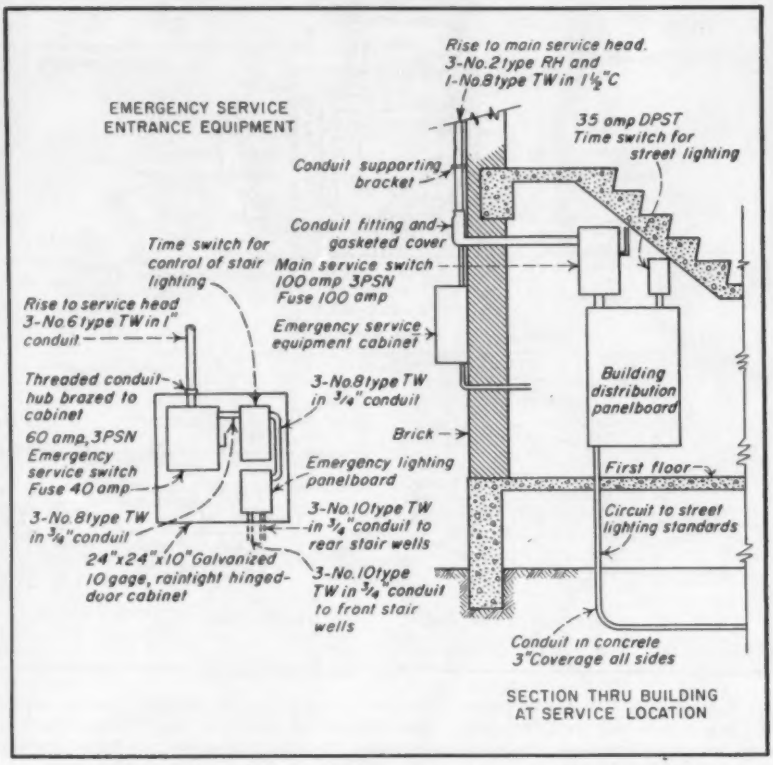



**4.** Pull box No. 2 is fed by phase "C" primary cable and the neutral from the utility pole. The two cables come into the box in a 3-inch fiber duct. An empty spare 3-inch fiber duct also runs into box No. 2 from box No. 1 and the utility pole. Single duct runs carry cables to the transformer poles. Details of the two pull boxes and the underground ducts are given here. Pull boxes are easily identified by the word "ELECTRIC" in large letters on the cover.

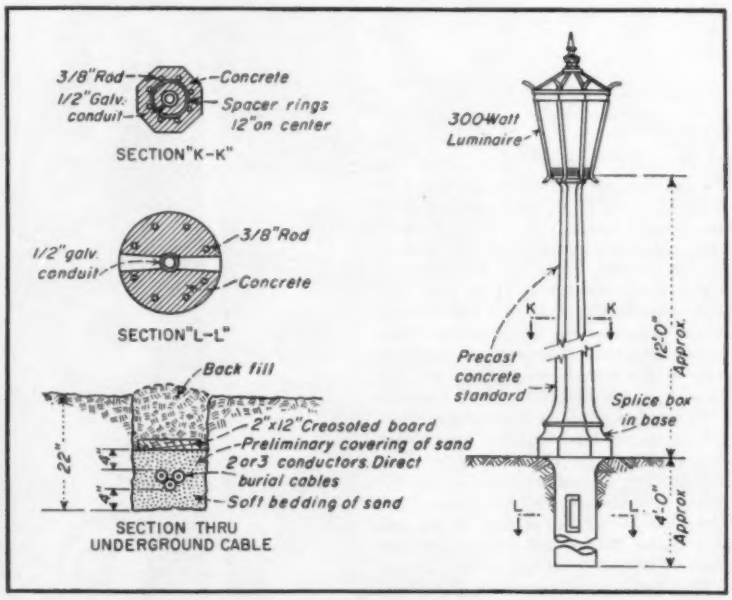


**5.** Phase "C" primary cable is carried continuously from the pothead connection on the utility pole, underground through pull boxes 1 and 2, then up in 4-inch conduit to a pothead (the one on the left in the photo) on the crossarm of this transformer pole. From this pothead, phase "C" is fed to the primary of the single-phase distribution transformer. The neutral is also run from box 2 up to the transformer. From the one pothead, a bare copper jumper connects to the second pothead from which phase "C" is carried continuously back down the pole, back through the same duct, through box 2 and in duct up to the second transformer fed by phase "C". There are no splices in any of the primary phase cables; all connections are made at potheads on the poles. Details of this pole-top arrangement for phase "C" are shown here. Typical details on conduit riser up a transformer pole are also shown.






**6.** Service drop to a typical building runs from a pole to a rack mounted to the underside of the roof overhang. Main and emergency service entrance conductors are carried from this rack in separate conduit runs to the main and emergency service entrance equipments. Three of the conductors in the drop constitute the 3-wire, single-phase 120/240-volt service; the fourth cable is the No. 8 circuit from a time switch in the building to the street lights on two poles. Size of SE conductors varies from No. 2 to No. 3/0, depending upon size of the building.




**7.** Sidewalk lighting is provided by standards of the type shown here. They are spaced as indicated on the layout; each is a 300-watt unit. Circuits for these lights come from the buildings and consist of rubber-insulated, neoprene-sheathed, direct-burial cables.

**FLUORESCENT SLIMLINES** form patterns of directional light for illumination of artwork at the new Whitney Museum, New York.

## *Paintings and Statuary Retain*

# True Color Without Daylight

**Conventional skylights and windows have been omitted in favor of carefully matched fluorescent and cold cathode lighting at the new Whitney Museum in New York.**

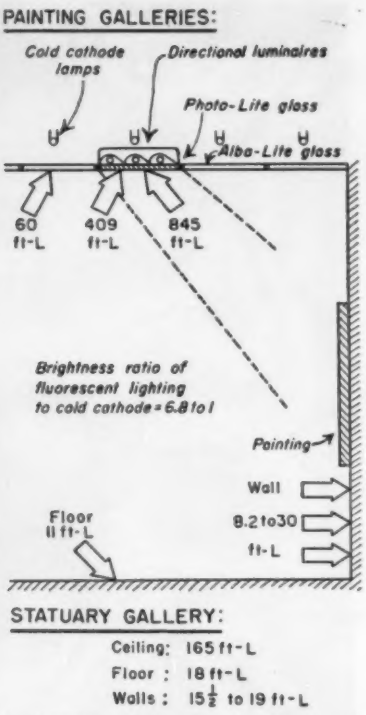
OVERALL luminous ceilings combining fluorescent slimline and cold cathode lamps provide the sole illumination for the galleries of the new Whitney Museum of American Art in New York City.

Lighting consultant Thomas Smith Kelly and architect August L. Noel, both of New York, have broken with tradition in designing the system to the total exclusion of daylight. Its success is evidenced by the accurate color quality preserved in the artwork and the complete absence of highlights, shadows or reflections. The architectural treatment, in providing no windows, has eliminated problems of glare and uneven lighting that would otherwise be encountered during daylight hours.

General illumination is accomplished on the second- and third-floor painting galleries by wall-to-wall, dimmer-controlled cold cathode tubing, while concentrated lighting for viewing the paintings comes from a perimeter system of 4-, 6- and 8-ft deluxe cool white slimlines in 3-tube directional luminaires. These luminaires are arranged in ceiling patterns which permit glare-free lighting on walls or partitions in various arrangements. The partitions supporting the paintings are movable and may be used to divide the large galleries into smaller rooms, providing additional wall space to suit the number or nature of the paintings being displayed.

A ceiling of 2 by 2-ft glass panels

**STATUARY ROOM** has an overall cold-cathode ceiling with provisions for the installation of spotlights when required for highlights.




**MEASUREMENTS** made soon after installation show average foot-lamberts.

½-in. thick is suspended on a fabricated steel framework beneath the lighting equipment. Homogeneous white Alba-Lite glass is used to diffuse the cold cathode light; 30-degree Fota-Lite panels direct the fluorescent light from the luminaires onto the walls or partitions. The directional properties of this glass are obtained through the use of photographically reproduced opal louvers within clear crystal glass. Light passes unrestricted through the clear glass to the walls, but the light source is not visible to the observer at normal viewing angles.

**BALLASTS** for fluorescent luminaires are grouped on racks in electric service rooms on second and third floors.

Luminous tube 12,000-volt transformers feeding the cold cathode lamps are located in the plenum, each transformer generally accommodating two rows of lamps. All fluorescent lamp ballasts are located in a bank in an electrical service room on each floor. Two-lamp ballasts are used throughout. One ballast feeds the first two lamps of a luminaire, while the third lamp plus the first lamp of the next luminaire are serviced by a second ballast, etc. The runs to the ballasts were made with 1000-volt, No. 14 synthetic insulated wire.

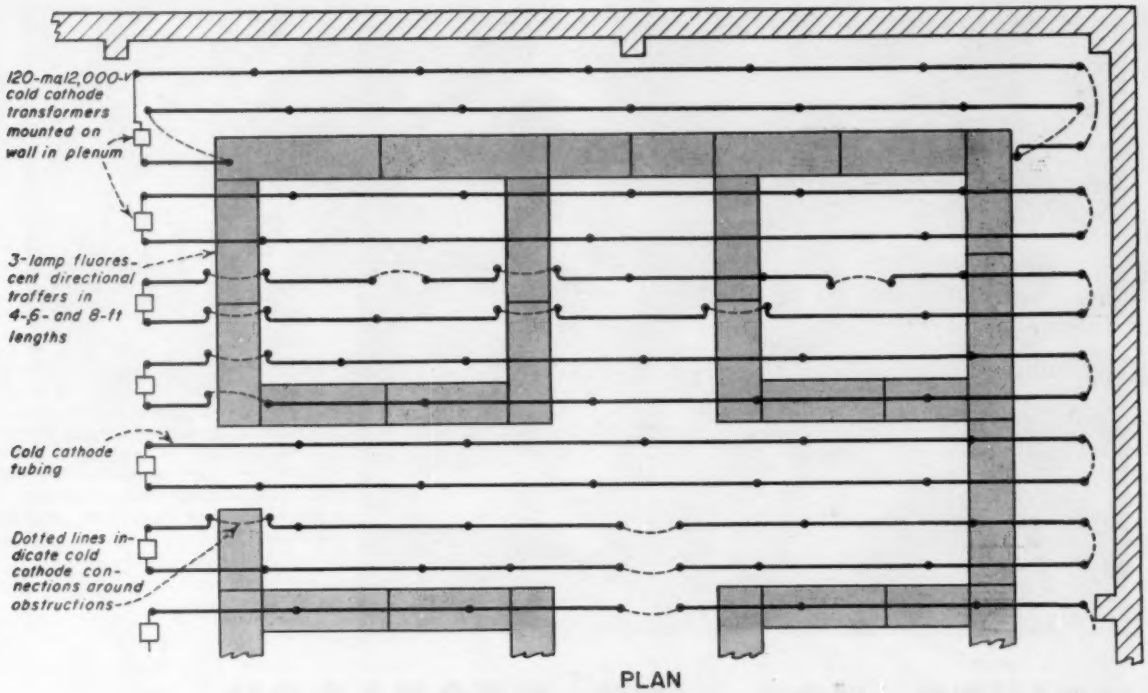
Also in the electrical service rooms are the auto-transformer type dimmers which control the voltage and hence the intensity of the cold cathode lighting. Such regulation provides a means of maintaining the proper brightness ratio between walls, directional lights, ceiling and floor.

Unlike the painting galleries, the sculpture gallery on the first floor has no directional fluorescent lighting. However, the rows of cold cathode lamps are spaced on 1-ft centers to provide a relatively high, even illumination which, at installation, measured 70 footcandles 30 inches above the floor. Provision has also been made above the glass ceiling for the introduction of spotlights should they be required to highlight individual pieces of statuary for proper display. More than 100 Twist-Lock receptacles are in place in the plenum to receive spotlight assemblies. The upper or female half of the receptacle is fixed to a ½-in. pipe stem and suspended in the plenum from a 4½-in. outlet box. The outlet boxes, mounted to channel framework, are connected together by conduit completely wired and ready to be used.

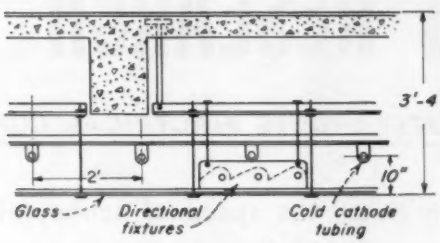
The male half of the receptacle is mounted on the end of the fixture stem, together with a metal escutcheon to finish off the installation at the ceiling. The conventional Twist-Lock has been modified so that the weight of the fixture is supported not by the contacts but by the receptacle body.

To install a spotlight, it is only necessary to remove the 2- by 2-ft Alba-Lite glass panel at the location desired, pass the fixture assembly through the ceiling framework, fasten together the halves of the receptacle, adjust the new glass in place, and fasten the escutcheon.

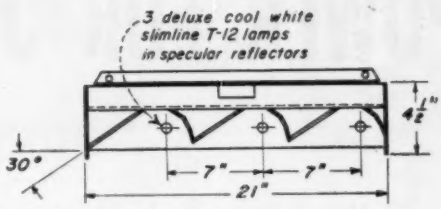
Electrical contractor for the job was Charles F. Zweifel & Co.; Leslie Wax Co. as lighting sub-contractor provided the cold cathode installation. Both are of New York City.




PLAN

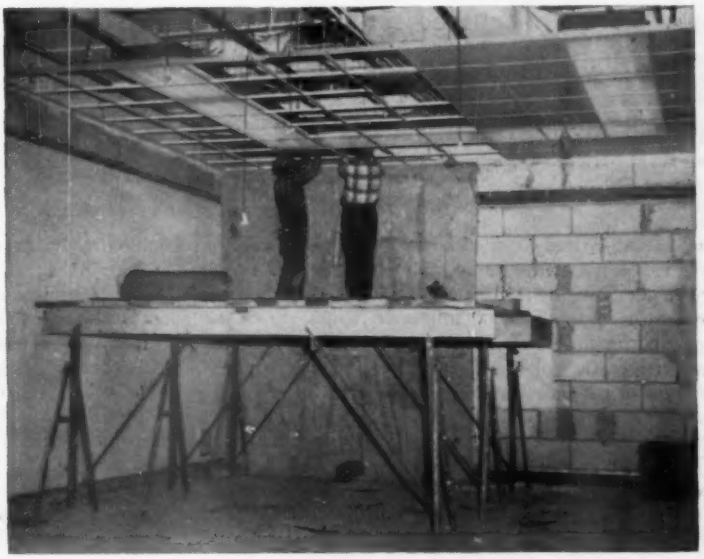



SECTION THROUGH CEILING




DIRECTIONAL FIXTURE

**PAINTING GALLERY** lighting details. Installation was aided by flexibility of cold cathode tubing where breaks in continuity were necessitated by obstructions in plenum. Vertical mounting heights of tubes given are average values. Modified paracyl reflectors of slimline luminaires direct glare-free lighting to paintings.



**CHOICE OF LAMPS** to produce maximum quality of light for viewing the paintings was complicated by the different transmitting qualities of the two types of glass used for the ceiling. The directional Fota-Lite glass passed more green, while the Alba-Lite glass beneath the cold cathode tubing transmitted more red.

Early experiments were made during construction of the building to obtain the best combination of slimline and cold cathode lamps. A typical finished wall section (shown at left in adjoining photo) was constructed and installed, on which paintings were hung. Lighting equipment for a complete bay was installed adjacent to the wall section, and the paintings were viewed under various lamp combinations.

Approximately 30 cold cathode lamps were made using different combinations of phosphor coatings. A process of testing and elimination narrowed the choice to two. The final approved color, given the name "Whitney White", was a combination of the characteristics of these two lamps, and in combination with deluxe cool white slimlines produced the best quality light in the opinion of the Museum staff, the architect, and the lighting consultant.


**SUPERSONIC** and transonic research is being carried on by NACA in airplanes varying widely in wing shapes, general design and physical dimensions. Included in this experimental group are such planes as the Bell X-1A (lower left) that established a speed record of 1650 miles an hour late in 1953.

# POWER FOR JET RESEARCH

## *OUTSTANDING ELECTRICAL CONSTRUCTION*

**Wind tunnels developing seven times the speed of sound, altitude chambers simulating conditions at 50,000 feet, drive units that place 150,000 horsepower on a single shaft, and hundreds of exacting research requirements have resulted in scores of unique installation features at NACA's mammoth Lewis Flight Propulsion research laboratory in Cleveland. These features, herein discussed, collectively add up to one of the outstanding electrical systems in the world.**

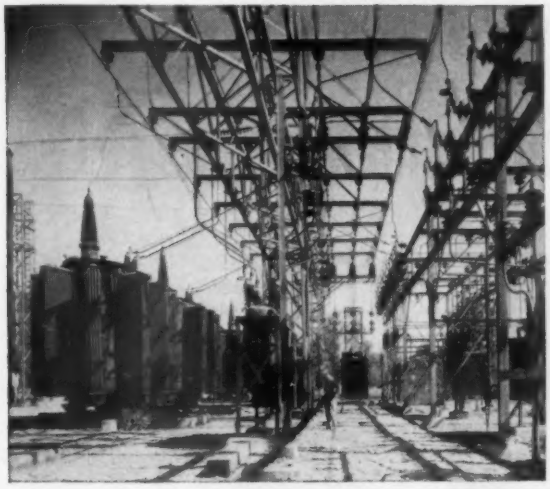
**By Kenneth D. Brumbaugh and Myron H. Pollyea**
*Electrical Engineering Division, NACA Lewis Flight Propulsion Laboratory, Cleveland, Ohio*

ONE of the nation's finest, largest and most unique electrical systems is to be found in Cleveland, Ohio, where NACA's Lewis Flight Propulsion Laboratory is literally "reaching for the stars" through fundamental research related to turbojet, turboprops, ram jets and rockets.

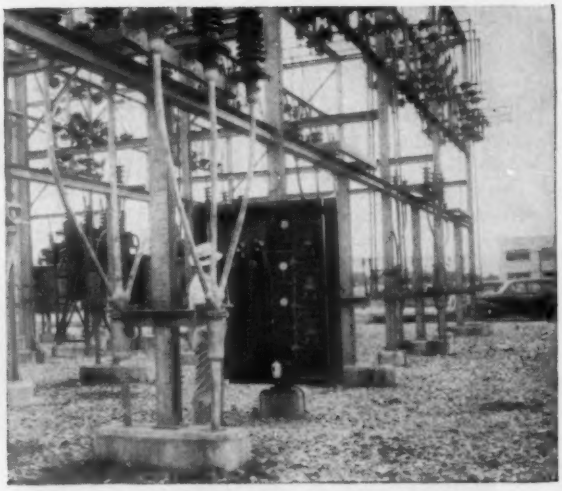
At present, incoming 132-kv power feeders have a capacity of 400,000 kva, and gross energy consumption is well above 20 million kilowatt-hours per month. Prime movers likewise are huge, as dramatically evidenced by a single supersonic wind tunnel where drive motors totaling 150,000 hp produce air speeds up to 2600 miles an hour. And, in this same laboratory, a large refrigeration plant utilizes over 25,000 hp to produce temperatures of minus 67 degrees to simulate altitude conditions at 50,000 feet.

The laboratory power system is connected directly to the main ring bus at one of the local utility company's main substations, and power is delivered to the laboratory's substation by means of four 132-kv circuits, carried as two double circuit steel tower transmission lines. From the laboratory's main substation, power is then distributed underground via lead-covered cables (solid, oil and gas-filled) into a network of area-serving substations. From these area substations power is furnished to laboratory facilities.

The system as it now stands represents a considerable change from the system initially planned and installed,



**MAIN 132-KV SUBSTATION.** Single-phase transformers (at left) step power to 34.5 kv for initial distribution. Copper tubular secondary bus is seen overhead. Oil circuit breakers (foreground) are rated 34.5 kv, 1200 amps, 1½ million-kva I.C. Grounding transformer and resistor are visible at rear.



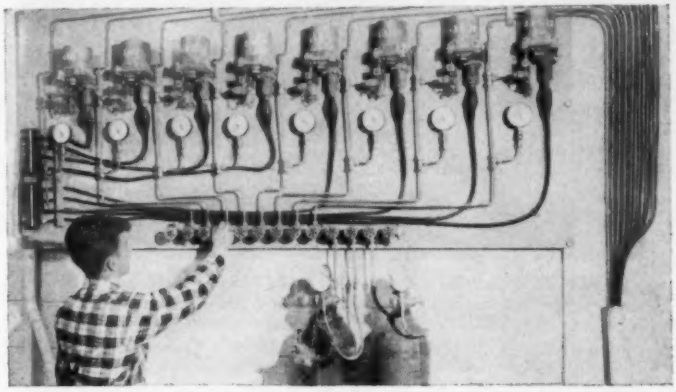
**GAS FILLED 40-KV CABLE** descends underground from three single-conductor gas-filled potheads (foreground). Copper tube leads from junction point at cable spreader to outdoor gas cabinet containing alarm pressure relays, manifolds and cylinders of super-dry nitrogen.

for spiraling power requirements have been constant, and changes to meet these demands have been great.

For example: the initial single 132-kv power line had an estimated capacity of 70,000 kva, and the air-blown capacity of the main transformer originally matched this figure. Since then, however, these values have been multipled five times.

Growth likewise dictated the rebuilding or replacement of many circuit breakers, for original computations concerning bus system short-circuit possibilities indicated values considerably below present computations. As a result, original breakers were revamped or replaced to handle the larger ratings, and all breakers for 33-kv use or higher are remotely controlled electrically.

Another problem related to growing power requirements pertained to the migration of compound in the solid-type cables originally installed. This migration evidently was caused by repeated extreme fluctuations in demand, for these demands varied from a few kilowatts to maximum values daily. This, in turn, resulted in intermittent temperature changes, frequent expansion and contraction reversals, and the ultimate deterioration of insulation. It was to solve this problem that low-pressure gas-filled cables were finally selected. Satisfactory performance of the new cables fully verifies the wisdom of the solution. Gas is super-dry nitrogen, constantly maintained between 10 and 15 psi, while cables are 3-conductor 500 MCM paper-insulated lead-covered.



**SUPER-DRY NITROGEN** for eight 500MCM gas-filled cables is furnished from two cylinders (one being a standby unit). Individual pressure gauge and pressure relay on each supply assembly warns attendant when pressures go below 10 pounds or above 15.

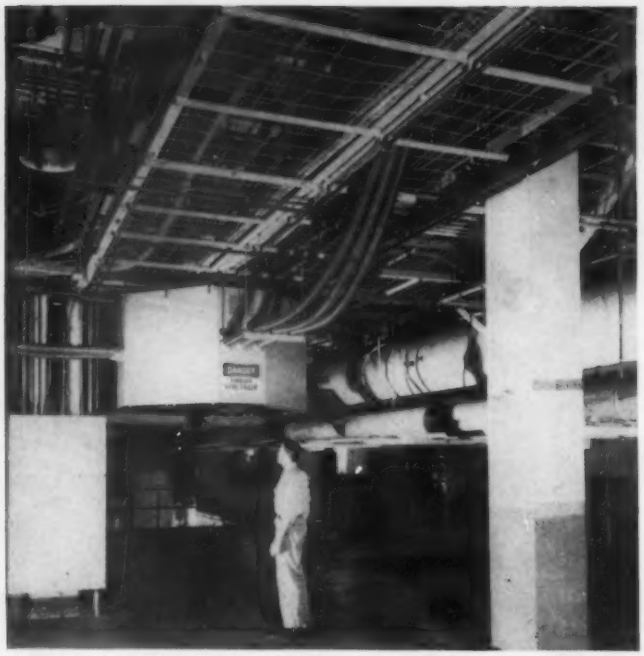
**The National Advisory Committee for Aeronautics, established by act of Congress in 1915, is a far-reaching governmental agency now operating four huge laboratories devoted strictly to fundamental aeronautical research. It is a vital integral part of the air-power structure in the United States, closely allied with manufacturing, civil operations and military endeavors.**

**As aeronautical science advances to new fields of higher speeds and higher altitudes, research problems have become closely interwoven with other sciences; propulsion now involving nuclear physics, and aerodynamics integrated with the laws of thermodynamics. And, in this expanding and deeply probing field, opportunity is afforded for wide-ranging studies that have become a challenge accepted by some of the finest minds in the country. The NACA laboratories provide scientists with the finest equipment for the study of their problems, making it possible to secure dependable knowledge unavailable from any other source.**

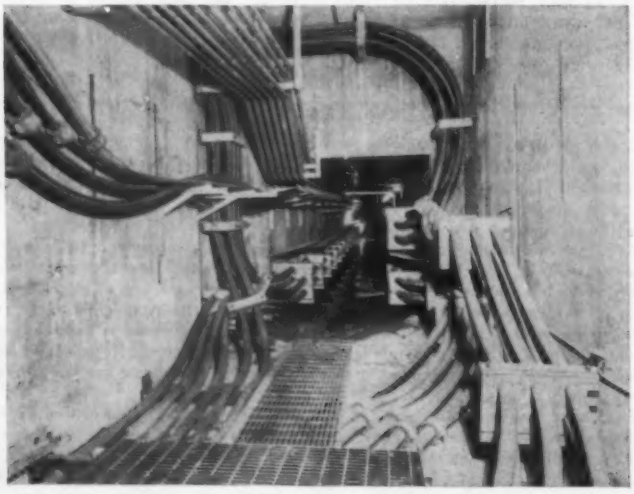
**The Flight Propulsion Research Laboratory at Cleveland, Ohio, is dedicated to all problems of aircraft propulsion. Towards this end, the Cleveland center contains nearly a hundred different research facilities devoted to the study of combustion, fuels, cascade aerodynamics, propulsion-system structures, high-temperature materials and lubrication. All types of modern and future systems for aircraft propulsion are studied there, including turbojets, turboprops, ram jets and rockets.**

**Electrical equipment at this laboratory includes some of the greatest concentrations of power ever assembled to operate the facilities, and the electrical system serving this $100-million research center is one of the finest anywhere.**

# Distribution Methods and Mediums



**BRONZE INTERLOCKING ARMORED CABLE** with 15-kv insulation are carried overhead on angle-and-metal-mesh racks, alongside of rubber-covered multi-conductor cables used for control and interlocking purposes. High-voltage junction box (seen below racks) is take-off point for power feeding two large test cells in the laboratory.



**CABLE TUNNEL** carries 6900-volt current to supersonic wind tunnel via 18 1500MCM annular bronze interlocked armored cables racked on maple blocks impregnated with paraffin. Bronze jackets are grounded at both ends and insulated at the center of the tunnel to limit sheath currents. Control cable is carried through rigid metal conduit and on asbestos trays.

ELSEWHERE in the vast distribution system, considerable use was made of bronze and aluminum interlocked armored cables (some as large as 2500 MCM)—variously carried overhead on angle-iron and metal-mesh racks, through tunnels on maple racks impregnated with paraffin, or supported by a variety of ceiling clamps or wall brackets. On long runs, such as through the tunnel leading to the supersonic wind tunnel, these armored cables were grounded at each end and insulated at their center points to limit sheath currents. These same cables (18 in all) are terminated in a plenum chamber located directly beneath three 29,000-hp drive motors, with special cable clamps incorporated in the design of the terminal potheads. Connections between potheads and motor terminals are via copper busbars.

Armored cable was used for several reasons. First, it permitted maximum flexibility for installation and routing. Second, it provided a simple means for expanding or revamping the system if that should be deemed desirable or necessary. And third, it greatly reduced the weight of the system.

For purposes of flexibility, expanded metal cable troughs are to be found in locations such as between research test set-ups and their related control boards. These open, readily-accessible trapeze-suspended troughs are used to carry thermocouple leads, warning and control wiring, instrumentation and small power circuits. And, since these circuits are varied for each new engine test set-up, the troughs are convenient, economical, time-saving and conducive to inspection or checking at all times.

To furnish power to fixed-location heavy equipment, busduct is also to be found extensively. Both ac and dc runs are installed for plug-in or direct-feeder purpose and, since busduct is installed outside (between substations and switchgear) as well as within structures, much duct is weatherproofed.

To serve moving loads, such as three cranes in the sheet metal fabrication shop, power is supplied through 3-pole trolley duct, separate runs serving crane bridges, trolleys and hoists.

Other problems at the NACA lab were related to the control of equip-

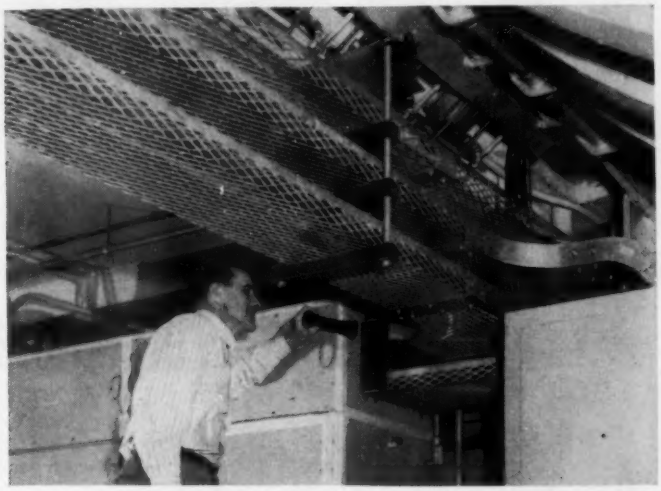
ment in the engine research building, where it was necessary to strike an acceptable compromise between the desire for accurate data obtained under unconventional and unexplored operating conditions, and the necessity for protecting not only engines under test but related equipments as well. This consideration of chain-reaction damage to equipment was necessary since the sudden stoppage of a test set-up could easily create huge, undesirable and dangerous power surges in the system as a whole. Protective measures therefore included such devices as overspeed, bearing temperature and blade-tip clearance indicators, flame detection equipment, automatic carbon dioxide dispensers for fire control, and the like, all electrically interlocked either with warning panels or with the engine controls directly.

Temperature, also, created problems, for our postwar shift from reciprocating to jet engines resulted in major increases in speeds, power and heat, with the result that temperatures of 600 degrees F became common. This dictated the use of glass-insulated wire in the high-temperature areas.

The shift from reciprocating to jet engines also greatly boosted horsepower requirements for compressors and turbines, for this transition in research resulted in drive motors jumping from 4 to 15 thousand hp.

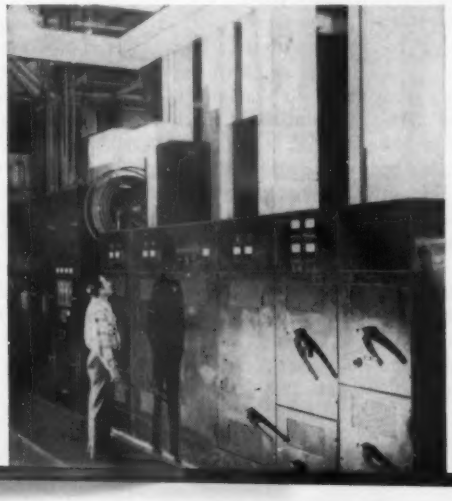
But while these power requirements are large they are far from being constant, for time cycles for actual tests are relatively short in duration, while the time required to make test set-ups is relatively long. It therefore became apparent that, by grouping all set-up test rooms having similar requirements, it would be possible to serve several areas from a single power system, provided that system incorporated a flexible power source.

**CABLE TERMINATIONS** for 8-by-6-ft supersonic wind tunnel feeders are at potheads equipped with special cable clamps. Framework supporting these terminals is located in plenum chamber beneath 87,000-hp drive unit. Lighting arresters and capacitors for surge protection are also included.

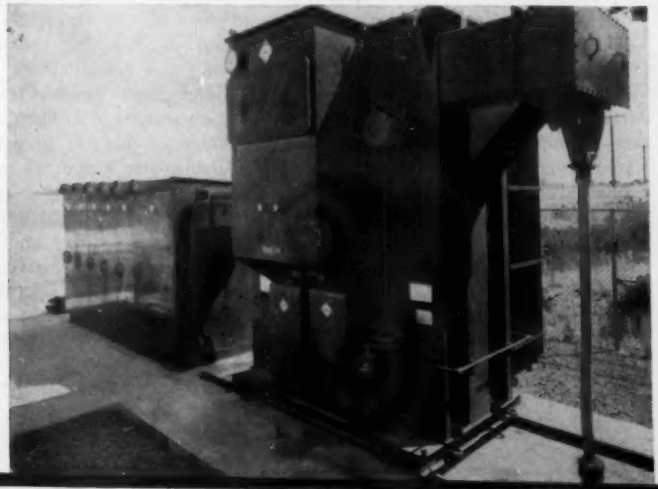


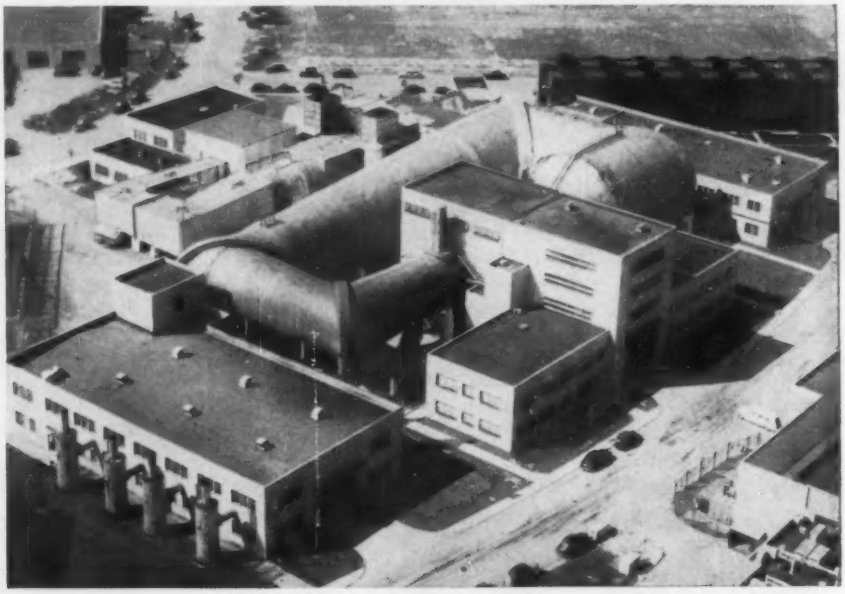
**EXPANDED METAL TROUGHS** are used between control panels and research testing areas to carry thermocouple leads, warning and control wiring, instrumentation and small power circuits. Since these circuits vary for each new engine test, these readily-accessible troughs are convenient and economical, permitting changes of circuiting at will and facilitating inspection.

**DIRECT CURRENT BUSDUCT** is used to supply dynamometers and resistance heating loads in the engine research building. Power is supplied to this switchboard by two synchronous m-g sets tied together by means of an equalizing bus. Subsequent distribution is through plug-in and feeder busses.



**TYPICAL OUTDOOR SUBSTATION,** for supplying combination lighting and small power loads where regulated voltage is required, features a 33-kv/2300-volt star delta 5000-kva transformer. Incoming and outgoing feeders are underground; secondary switchgear contains oilbreak units rated for 50,000-kva interrupting capacities. Incoming power supply and outgoing feeders are via underground lead-covered cables.





**AIR VIEW** shows altitude wind tunnel at Cleveland laboratory, where experimental data are obtained by the NACA to aid our country's aircraft manufacturing industry as well as our Air Force and Navy designers. Wind tunnel, together with more than a hundred other facilities at this laboratory, is served through primary substation having capacity of 400,000 kva.

# Variable Frequencies and Loads

A VARIABLE-FREQUENCY power plant with selective switching was designed to maintain constant torque between 10 and 120 cycles. And, for even greater flexibility, the plant was further designed as a 3-group unit, each group consisting of a 3750-kva 3-winding transformer, a 2650-hp constant-speed m-g set, plus three 1500-kw variable-frequency motor-generator combinations.

Secondary windings of the transformers provide 6600 volts to operate 15,000-hp 3600-rpm synchronous motors, while tertiary windings provide 790 volts for slip rings of variable-frequency generators. Field excitation for the synchronous motors and the dc drive motors of the 1500-kw converter sets is supplied by 250-volt dc regulated generators.

Research drive units using the variable frequencies include 1½-, 3-, 6- and 9-thousand hp induction motors in addition to the 15,000-hp synchronous units just mentioned. All of these units are used as motors to drive compressors but may be used as generators to absorb power when gas turbines are being operated.

All nine of the 1500-kw m-g sets in the system are parallel-connected and may be used in various combinations depending upon the arrangement of selective switchgear. By this method, one set may be operated to serve a 1500-hp motor, two sets may be parallel-connected to serve a 3000-hp unit, or all nine may be linked when a 15,000-hp motor is in operation.

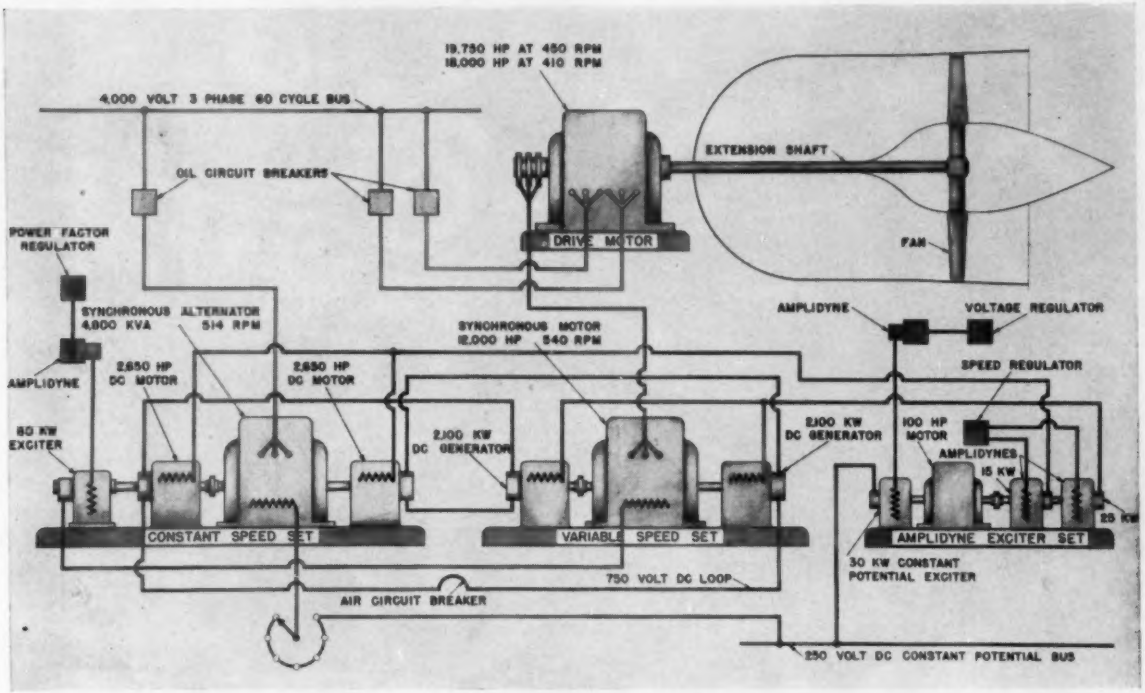
Concerning the three 2650-hp constant-speed motors, each of these units in turn drives three d-c generators (nine in all) for the variable-frequency m-g combinations.

Since these variable-frequency sets can be rotated in either direction, frequencies of rotation (impressed on the 790-volt rotor windings) may either be additive or subtractive, with output frequencies ranging from 60 to 120 cycles when additive and from 60 to 10 cycles when subtractive.

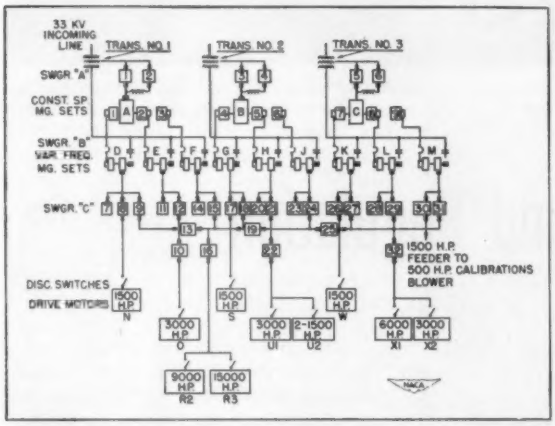
It is apparent that operation of these testing set-ups results in a high order of overall electrical diversification and demand. And these variations are further magnified by the laboratory's intermittent use of supersonic, altitude and icing wind-tunnels, requiring high demand peaks for brief intervals.

Accurate prediction of power requirements is understandably difficult, although intelligent regulation of loads is greatly aided by direct telephone connections between the laboratory dispatch office, all major lab test facilities, and the power dispatcher who is stationed at the Cleveland-area-serving utility plant.

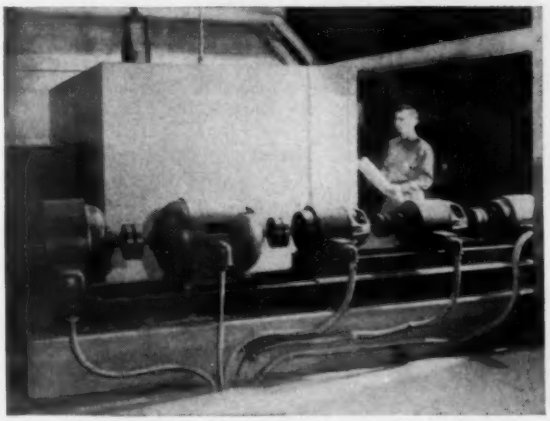
Through this intercommunication system, tests requiring large blocks of power can then be progressively scheduled so that surges in power will be minimized as much as possible within the lab itself. Moreover, large blocks of power required by the laboratory can be arranged to coincide with dips in the power company's daily demand curve. As a result of this practice, many wind-tunnel tests are performed at night when other normal lab-wide and city-wide power requirements are at an ebb. This phone intercommuni-




**ELECTRICAL DRIVE SYSTEM** for altitude wind tunnel consists essentially of a constant-speed plus a variable-speed m-g set controlled by amplidynes. Speed variations are maintained within ¼ of 1 percent accuracy by varying the fields of the dc machines in the loop circuit. Amplidynes automatically maintain constant potential, frequency and power factor.




**VARIABLE-FREQUENCY POWER SYSTEM** consists of three groupings of equipment. Each group contains a 3-winding transformer, a constant-speed m-g set, and three variable-speed converter sets which are parallel-connected in various combinations by means of selective switchgear to serve any of the 1½-, 3-, 6-, 9- or 15- thousand-hp drive units.

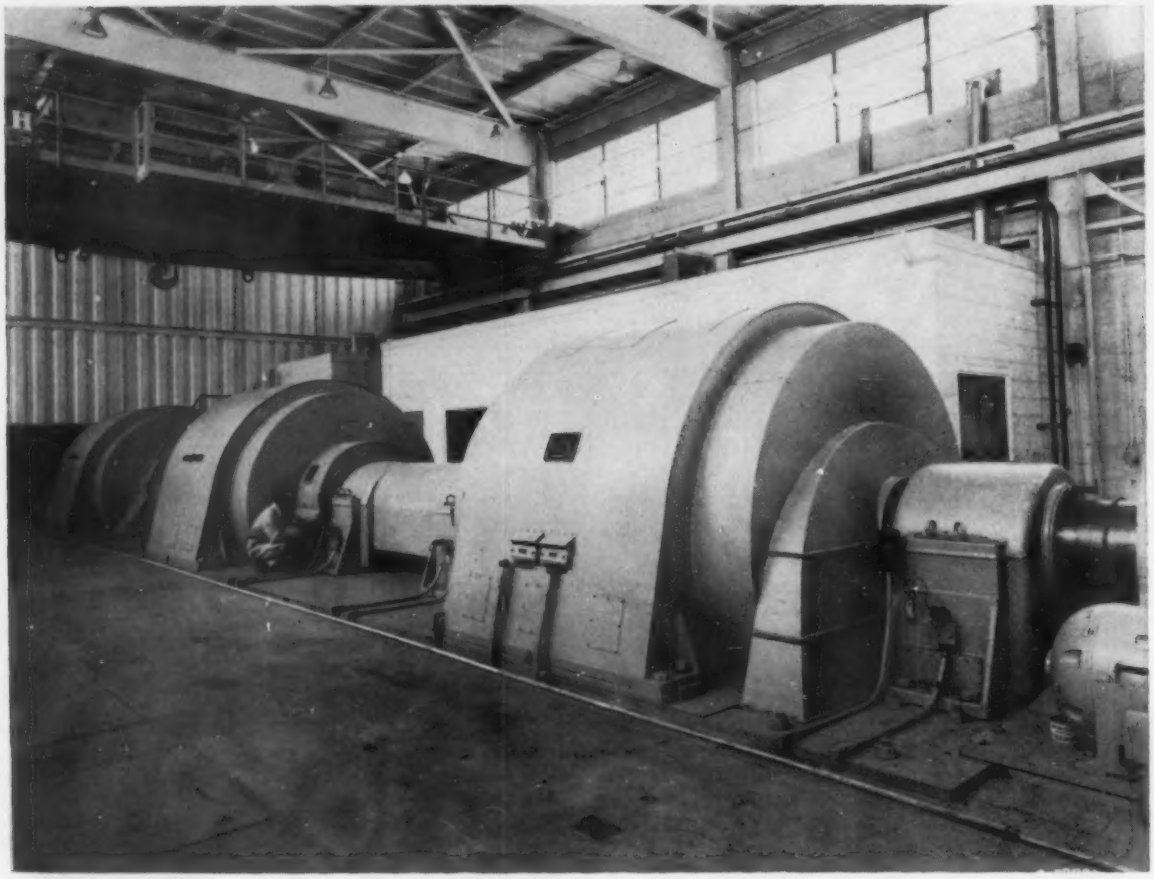


**FIELD EXCITATION,** for synchronous and dc drive motors of a typical variable-frequency power group, is supplied by a dc generator (left), coupled by the same shaft to an ac induction drive motor and three dc control generators. Power is supplied to a constant potential bus by SN wires carried in steel conduit installed in the concrete slab.

cation system also advises power dispatchers when large loads are to be built up gradually or dumped suddenly, permitting them to adjust their systems accordingly.

To date, the arrangement has proved highly satisfactory to both the power company and the Lewis Laboratory, particularly so since the original telephone cables (found to be vulnerable to occasional inductive surges in certain parts of the system) were replaced with railway signal cable.

Indicative of this practical synchronization of loads and studied use of equipment is the fact that the lab's power factor ranges from 90% (with the supersonic tunnel operating) to 99% (when synchronous equipment is in maximum use). The average annual load factor, however, is only approximately 18%, while the total connected load within the lab grounds is above ½ million kw.



**87,000 HORSEPOWER** drive a thousand-blade compressor in the 1500-mph supersonic wind tunnel. Liquid rheostats regulated by amplidynes control speed accurately within 610 and 880 rpm. Shaft is rotated frequently to prevent deformation.

# Power Control and Regulation

ANOTHER interesting electrical feature in the laboratory is the use of amplidyne controls in the various wind tunnels.

For example, in the 87,000-hp 2¼-million-cfm supersonic wind tunnel (constructed to permit the study of full-scale jet engines in operation at speeds up to twice the speed of sound), air is dried, then forced through the tunnel by an axial-flow compressor having a total of approximately a thousand blades. The three 29,000-hp 8-pole wound-rotor tandem-mounted drive motors are accurately controlled between 610 and 880 rpm through the use of amplidynes operating liquid rheostats connected to the rotors.

Motors for this installation are totally enclosed and fitted with water-to-air heat exchangers and axial-flow blowers for cooling. And, although running in tandem mechanically, they are hooked up in parallel electrically. With current in this high range, it was necessary for stators to be connected to a 3-phase transformer, with circuit breakers located in the primary windings to permit the motor-transformer combination to be switched in as a unit.

Each of the three 29,000-hp motors is individually equipped with bearing temperature relays, stator resistance-temperature detectors, differential protection, surge protection and ground protection. Each unit also includes space heaters and ventilation blowers with heat exchangers.

Due to the extreme weight of the shaft, and the possibility of this weight causing deformation of the shaft between bearings during periods of idleness, a special turning motor and gear is provided at the end of the main shaft for the purpose of slow rotation. This method is also used to turn motor and compressor rotors for inspection, repair and maintenance purposes.

Stable operation of the motors is obtained by slip-regulators of the liquid rheostat type, each regulator requiring three 20-ft-high tanks for containment. A separate regulator governs each of the three drive motors; the first regulator acting as a master and the other two acting as followers. Each regulator consists of movable electrodes

which are connected mechanically to a hoist mechanism and are connected electrically through an electrolytic salt solution, thereby forming a wye-and-neutral circuit which is external to the motors themselves. Equal values of resistance can be placed in this circuit for each phase by moving the electrodes nearer together or further apart. This positioning is done by means of a reversible dc motor on each regulator. Amplidynes furnish the power and control for these small motors.

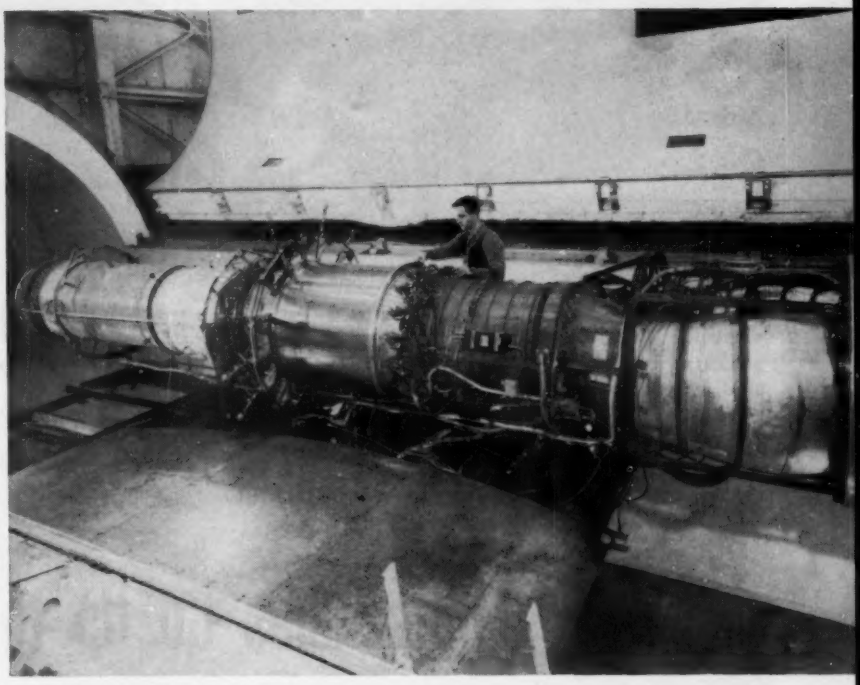
These slip-regulators change the resistance in the secondary winding circuit to alter the amount of current supplied to the drive motors, thus changing the speed according to the characteristics of the wind-tunnel compressor. Rheostats also regulate the starting sequence of the drive motors since (due to the excessive currents drawn by the motors) it is necessary to start them separately and in sequence, letting each one reach 50% of its full primary load before the next unit is cut into operation.

In the altitude wind tunnel, however, the 19,750-hp wound-rotor motor is accurately controlled between 90 and 410 rpm by a system consisting essentially of one constant-speed and one variable-speed m-g set controlled by amplidynes, with all slip energy (minus machine losses) returned to the line to keep efficiency at a maximum. With amplidynes automatically maintaining constant power factor, frequency and potential, speed variations can be maintained within ¼ of 1%.

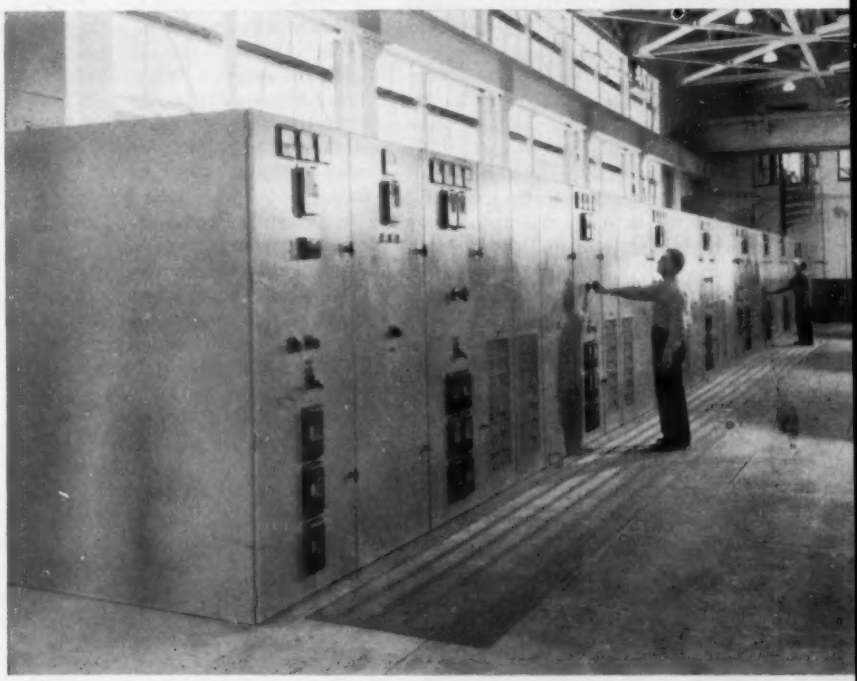
In this second arrangement, the rotor of the main drive motor is connected directly to the variable-speed m-g sets, and the dc machines on both the constant-and variable-speed sets are series connected to form a loop circuit.

### *Starting Sequence*

In operation, low initial kva is possible by first starting the constant-speed unit. Then, after this set has reached synchronous speed, the variable speed unit is brought up to provide 60 cycles, and both line voltage and frequency on the stator of the main drive motor are accurately matched through proper excitation at the rotor. Running circuit breakers are then closed and, again after synchronization, the speed at any instant is proportional to the difference between stator and rotor frequencies. This second tunnel, incidentally, duplicates flying conditions up to 500 mph at 50,000 feet elevation.

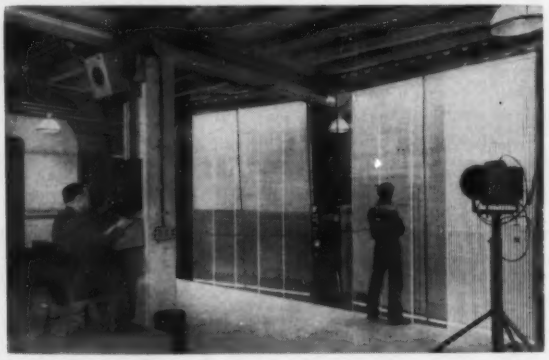


**TURBOJET ENGINE** performance is studied over its full range of power and altitude in the Lewis Laboratory altitude wind tunnel. Here a mechanic checks the fuel injection system at the inlet burner prior to a test. Wide range of operating conditions is obtained through adjustments of tail pipe nozzle.



**METALCLAD SWITCHGEAR** to operate four exhauster and four compressor motors is supplied at 6900 volts from two 13,333-kva transformers linked together through a central tie breaker. Weatherproof busduct is used between switchgear and outside substation; bronze interlocked armored cable between switchgear and motors. Motors (ranging from 2500 to 5000 hp) start on reduced voltage, requiring start and run circuit breakers plus starting reactors.

**AIR DISPATCHING CONTROL ROOM** for the engine research building. On the wall panels are pressure and ammeter instruments, also multi-colored pinpoint lights on diagram boards to show valve positions on altitude, refrigerated and combustion air systems. With 2-lamp glass-paneled fluorescent fixtures recessed into the 10-ft ceiling, and a continuous bank of inclined incandescent cove fixtures located above each wall panel, illumination is commendable.



**MANOMETER BOARD LIGHTING** consists of reflector photo spotlights on 9-in. centers mounted overhead and 10 inches in front of the manometer tubes. Clear lucite panels (10 ft high) are placed in front of the lights and are inclined inwards at the bottom to kick light towards the tubes. Resultant illumination is in excess of 170 fc on the vertical plane. High lighting intensities are necessary for high-speed photographing purposes.

# Footcandles Go Up to 170

THROUGHOUT the laboratory, lighting is outstanding, with many excellent conventional treatments used for various research cells, offices, the cafeteria, library, lobbies, exterior substations, roadways and the like.

In many other areas, however, lighting transcends accepted practices and definitely enters the pioneering and experimental fields. For example: in the several dozen control rooms, an impressive variety of different treatments is used for both general and specific area lighting. Both recessed and surface-mounted fixtures are used with different colors of lamps, different shielding and diffusing mediums, different arrangements and different circuiting.

To illustrate: the central control room in the engine research building is semi-circular in form, with wall-mounted instruments and diagram boards around the room and an inclined-top remote control desk in the center. The room, measuring 45 ft across with a 10-ft acoustical tile ceiling, is generally illuminated by recessed 2-lamp 40-watt fluorescent troffers equipped with frosted ripple-glass bottom panels. Lamps are standard cool white, and average intensities approximate 40 footcandles from this one source.

Wall panels are additionally illuminated by overhead incandescent coves which are inclined from the edge of the slightly-dropped ceiling towards the instruments. Each cove section (8 ft long) contains 12 100-watt lamps in spun aluminum Alzak reflectors with diffusing panels of sand-blasted lucite.

On the diagram boards themselves, pinpoint pilot lights indicate valve locations in the air dispatching system of the building, while colors indicate valve positions (such as red, white, amber and blue jewels to designate open, closed, permissive control and interlock arrangements).

Another example of specialized lighting may be found in manometer rooms, where hundreds of 10-ft-high manometer tubes (remotely connected with parts of engines and planes under test in adjacent wind tunnels) give a continuous visual indication of the stresses being developed in different materials or assemblies under constantly-changing test conditions. Since these stresses are subject to rapid variation, the banks of manometer tubes are intermittently photographed while the tests are in progress. Then, after completion of the tests, the developed and enlarged photographs can be studied under magnifying glasses and, by this procedure, engineers can obtain a wide range of data essential to further intelligent research.

For high-speed photographing purposes, therefore, it is apparent that the manometer boards must be evenly illuminated with high levels of light, yet specular reflection must be minimized. This combination is obtained by top-lighting the manometer boards through the installation of No. 2 photo spotlights, located on 9-in. centers, 10 inches in front of the board. Then, to kick downlight inwards towards the manometer tubes and also to kill specular reflection, 10-ft-high sheets of clear lucite are located in front of the lights. Lucite sheets are generally inclined inwards (from top to bottom) at a 20-degree angle, although this angle may be varied by means of adjustable extension rods located at the top of the sheets.

This treatment delivers an even blanket of light, in excess of 170 footcandles, to the surfaces of all tubes. Aluminum border plates shield the camera lens from direct lamp brightness. And circuiting uses a 3-phase 4-wire system (4 lamps per phase), operated through contractors by remote control switches.

All the electrical features herein discussed provide an essential framework for aeronautical progress, for they have indirectly contributed to the development of successful new power plants for aircrafts, new fuels with greater energy content to meet the requirements of open-cycle jet engines, and new materials with increased resistances to high temperatures and stresses.

# WIRING PORTABLE CLASSROOMS

**Mobile units are solving Seattle's problem of fluctuating and shifting requirements for school buildings. Industrial Electrical Company used a wide assortment of power tools, special jigs and practical installation techniques to keep cost down and quality up.**

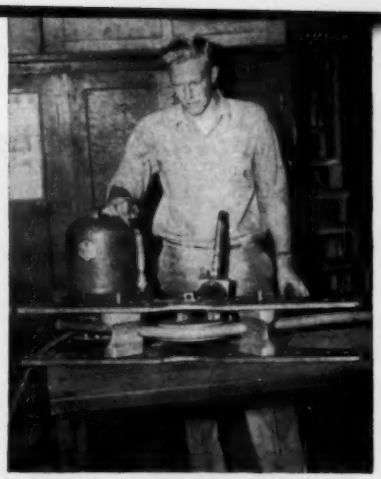
**By Hugh P. Scott**

MANY cities are now in the process of investigating possible solutions to the problem of providing school facilities for changing needs. In Seattle, Wash., the problem is being met through the construction of one-room classroom units which are portable; may be readily moved around the city by trailer truck, and may be combined with other similar one-room units to form any desired arrangements or grouping. To date, 200 such units have been constructed.

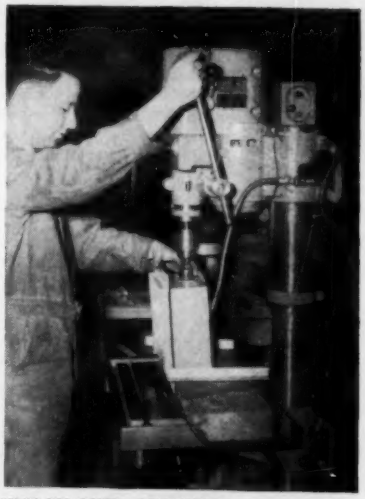
These rooms are constructed along plain functional lines and are simple in design, providing useful facilities at an extremely reasonable cost. Moreover, they may be used as single classrooms in small isolated settlements, may be added to already constructed school buildings as temporary additions, or may be interconnected by common corridors or breezeways to serve as coordinated rural educational centers. They also lend themselves to mass-assembly techniques, and are being assembled completely with prefabricated and pre-assembled components.

Electrically, each room has its own service entrance, meter and control cabinet. Lighting is provided by six stem-mounted silvered-bowl 500-watt incandescent lamps in annular-ring fixtures, and electrical connections and outlets are provided for a clock, signal buzzer and porch light. Each room measures 32 by 24 feet in plan and has an 11-ft clearance from floor to the underside of roof beams. The unit has one wall completely devoted to windows and the remaining walls, with the exception of a door, are blanketed with insulation. Insulation is also used beneath the flooring and between ceilings joists, while a self-contained unit heater provides warmth during the winter months. Chalk boards, tack boards, closets and other essential facilities are also included.

On this project, the electrical work is being done by the Industrial Electric Company of Seattle on an efficient shop-assembled basis. For example, before sending an installation team into the field, rigid conduit service entrances (for underground as well as for overhead power feeders) are cut to exact lengths, threaded, bent in accordance with a template pattern, then equipped with all necessary bushings, washers and entrance heads. Control panels are drilled for off-center conduit connections, necessary to obtain desired alignment of panels on the job, and panelboard-meter assemblies are accurately checked in the shop for overall dimensions, so as to exactly coincide with mounting positions in the classrooms. Lengths of conduit for lighting, clock and buzzer systems are also cut, threaded and reamed in



**HYDRAULIC BENDER,** electrically operated, forms rigid conduit service entrance for pre-fabricated one-room unit classroom. Conduit is also cut to length, threaded, reamed and equipped with entrance cap before leaving shop.



**KNOCK-OUT OPENINGS** in panelbox are shifted off center to permit exact alignment of service equipment. Drill press, large diameter cutter and fixed positioning bracket combine to provide fast, accurate results.

**BENCH-TYPE WIRE STRIPPER** is used to remove insulation cleanly and quickly. Stop bolt automatically sets length of stripped end section. Overall length of wire is also measured and cut in the shop, reducing field operations.

**FLEXIBLE CONDUIT,** which will extend from panelbox to porch light of classroom, is also cut to length in the shop. Wire ends are then stripped, terminal connectors attached and bushings inserted for fast field installation.

**BUNDLING** of signalling assemblies (with conduits, receptacles, stubs, locknuts and mounting straps pre-assembled) facilitates easy counting, storage, transportation and handling between shop and installation depot.

**ELECTRIC SAW** is one of many power tools used to simplify installation work on the Seattle mobile-classroom project. Temporary power is provided at levels of 110 and 208 volts, with feeders terminating in polarized twist-lock receptacles.

**DELIVERY TRUCK** is fitted with roof racks for ladders and interior bins for tools, wiring accessories, extra lengths of conduit and spare components. Materials are delivered as needed, thereby eliminating on-the-job storage.

**CONDUIT EXTENSION,** with box already secured to one end, is merely inserted in knockout opening of previously-positioned central outlet, then fastened with additional bar hanger. Precut conduits guarantee center-to-center dimensions.

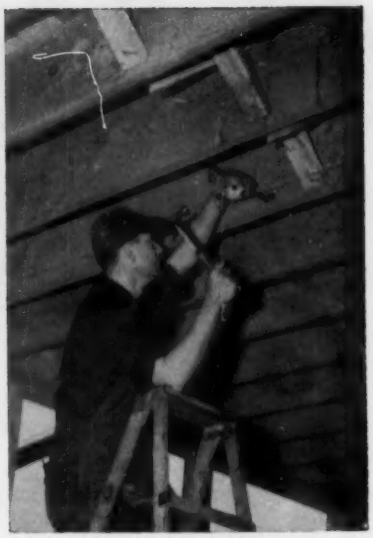
the shop; specific knockouts are shop-removed from outlets boxes, and exact lengths of wire are cut, stripped of insulation for predetermined distances, and made ready for fast field connection without requiring additional preparation on the job-site. Components are then bundled, tied in convenient lots and stored for use on a moment's notice.

In all of these operations, electric and hydraulic tools are used whenever possible. Extensive use is also made of special jigs, templates and limit stops for the automatic measurement of conduits and wire.

All of this shop preparation and preassembly results in maximum efficiency at the actual fabrication depot where the one-room units are mass produced. Field efficiency is further aided through the availability of temporary power, resulting in the utilization of electric saws, drills, sanders and the like. These efficiency-promoting tools are used for such purposes as cutting openings in the exterior sheathing of buildings for entrance conduits, meter pans and porch light outlets; drilling joints and studs to permit the passage of flexible conduit, and establishing bolt holes for the anchoring of service terminal insulators. With all openings and shop-assembled components accurately measured and positioned, actual field installation is in

**PACKAGED SERVICE UNIT** is connected quickly, with entrance conduit dropping to already-linked meter pan and control panel, and flexible branch extending to porch light outlet. All wires are pre-cut to length and stripped.

**METER PAN,** framed with weatherproof gasket, is located beneath service terminal insulators and entrance cap. Flexible lead for entrance light awaits installation of canopy above doorway. Doorways open on common breezeway.



**CENTRAL LIGHTING FIXTURE** outlet boxes are aligned with taut string line as guide, then secured between ceiling joists by expandable bar hangers. Knockout blanks have already been removed to receive conduit connections.

"no time flat". For example, a prebent entrance conduit slips through the related sheathing opening and is secured to a meter pan which snugly fits into its pre-cut wall niche. Since the control panel is already connected to the meter pan by means of a conduit stub, it is merely positioned to face inward, then is blocked out flush with the interior wall surface. From this panel, flex connections are run to the porch light outlet and to the nearest ceiling fixture. Pre-cut and insulation-stripped wire is then pulled into these wireways to complete this phase of the work.

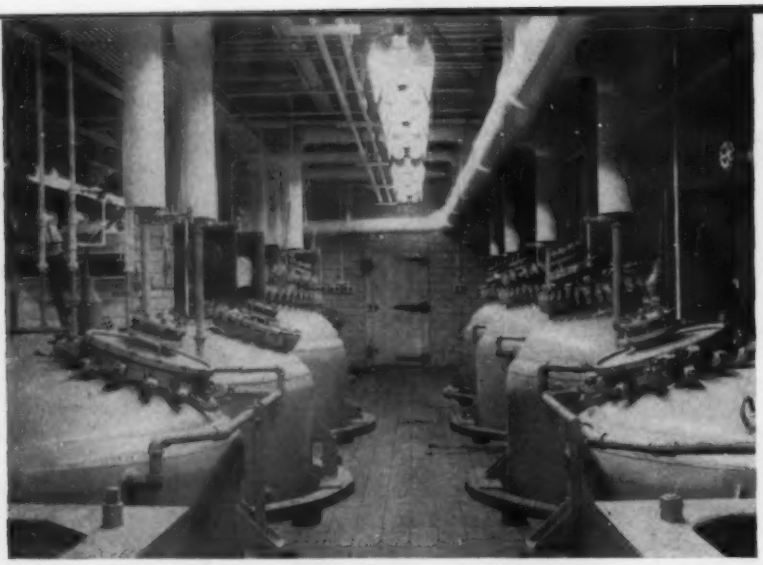
Another illustration of field efficiency is related to the installation of the interior lighting system which consists of six fixtures arranged as two rows of three fixtures each. Since rows are 12 feet apart and outlets in each row are spaced 8 feet center-to-center, the first step is to locate the two central boxes, using a taut string line for accurate alignment, and using expandable bar hangers between joists as the mounting means. As already indicated, these boxes have had knockouts removed to receive the ends of conduits extending to other fixture points, so installing these pre-cut and pre-threaded conduits (with boxes already attached on the far ends) simply becomes a matter of conduit insertion in a knocked-out opening, the securing

**CLOCK AND SIGNAL** outlets are also completely shop-assembled, greatly simplifying the field routine of installation. All of these shortcuts, plus the use of power tools and careful planning, contributed to Seattle's low-cost flexible school plan.

of locknuts, alignment of extension arms, and nailing of additional expandable bar hangers to hold the four corner fixture outlets. Again, the wiring job is completed by pulling in pre-measured and pre-stripped wire, making the necessary connections with threaded wire nuts.

Temporary power for 110- and 208-volt tools and equipment is provided through color-coded neoprene-jacketed cables, run underground to conveniently-located utilization points, and terminating in polarized twist-lock weather-proof receptacles. Utilization points are located centrally between every four rooms under construction.

All pre-assembled components are delivered from Industrial Electric's shop to the installation site in panel trucks equipped with roof racks for ladders, and special bins for necessary tools and incidental parts. Also, to safeguard against the possibility of overlooking some minor detail, the truck carries a few extra lengths of rigid conduit, a reel of flexible conduit, a few spare meter pans, control panels, receptacles, clock outlets, couplings, nipples and the like. The truck also carries an assortment of hand tools for unexpected jobs. To date, however, Industrial's care in pre-planning and preassembling the work has made it unnecessary to draw from this emergency stock.



**EXPLOSION-PROOF** fluorescent luminaires are installed in continuous rows to light extraction tanks in Armour and Co.'s new Pharmaceutical Center plant at Kankakee, Ill., where modern drugs are processed with the aid of various flammable extraction agents. Intensities range from 25 to 60 footcandles.

# EXPLOSION-PROOF FLUORESCENTS

**Fluorescent lamps, encased in heat-resisting glass tubes mounted in cast luminaires, provide illumination and safety throughout Armour and Company plant where flammable solvents are used.**

EXPLOSION-PROOF fluorescent lighting is an important safety feature at Armour and Company's new Pharmaceutical Center, Kankakee, Ill. Here, where tons of frozen animal glands and organs are processed daily to yield minute amounts of powerful biologicals—insulin, thyroid, ACTH, pituitary hormones, and other drugs—various flammable solvents are used as extraction agents. Ether, an extremely explosive substance, for instance, is employed in the manufacture of insulin and gamma globulin.

Volatile flammable liquids require a relatively low ratio of vapor to air to create an explosive mixture. Thus extraordinary safety precautions are taken at the new Pharmaceutical Center in the storage and handling of its extraction solvents. These include the installation of Crouse-Hinds type EVF explosion-proof luminaires and other explosion-proof devices including the electrical wiring, to minimize the hazardous effects of the solvents. Through these devices they have been able to provide the same conveniences and efficiencies—such as ample illumination—that are enjoyed at other areas of the Center where flammable solvents are not a prime safety factor.

The type EVF fluorescent luminaires consist of two or more lamps, protected by tubes of heat-resisting glass sealed at the ends into cast aluminum socket housings. Threaded to the housings are removable covers with flame-tight joints. A flammable mixture can enter the cover joints and explode inside the luminaires without effect upon the surrounding outside flammable atmosphere. Two factors provide this protection: after an explosion has occurred inside the housing, the threaded joints allow the mixture to escape only as cooled exhaust gases; and the cast housings are strong enough to contain any number of repeated explosions without damage.

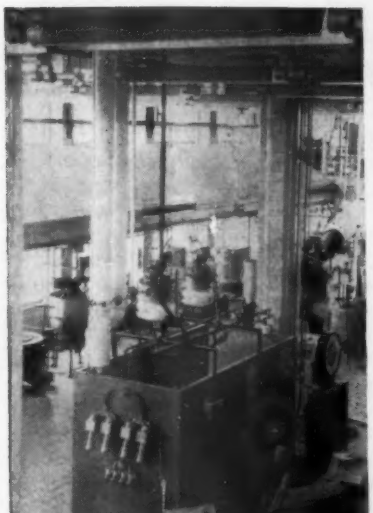
Explosion-proof fluorescent lighting is used extensively throughout the processing areas at Armour, including those with very high ceilings. Included is the area where initial processing is accomplished in more than 70 glass-lined tanks set half way between floors, which are filled from the second floor and emptied from the first. Further refining is done in smaller tanks of similar construction and function.

Not only are the type EVF luminaires explosion-proof, but also installed end-to-end wherever necessary, in continuous-line fashion, to provide maximum illumination. In spite of their end-to-end placement, they are easily relamped due to their construction. Receptacles at the ballast ends of the units are pivotally connected to the ballast housing. The receptacle housings at the other end, or relamping end, are connected to the supporting stem assembly which is attached to the ceiling or structural member of the building. A link member, part of the supporting stem assembly, allows the receptacle housing to be lowered for relamping. By removing a threaded cover at the end of the tube, the lamp and socket are exposed. Without special tools, these units may be released and the lamp withdrawn and replaced.

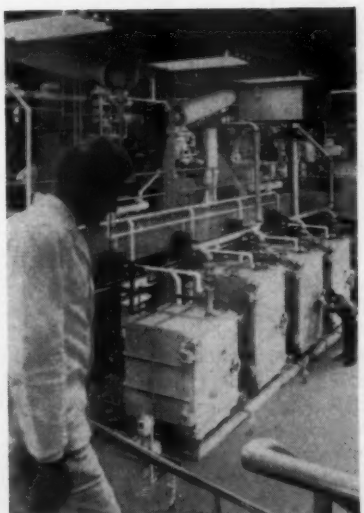
Lighting intensities, with the luminaires using 90-watt T-17 standard white fluorescent lamps, vary from 25 to 60 footcandles on the work areas, depending upon the type of work and the placement of the luminaires.

**TANK ROOM** is completely explosion-proof. Crouse-Hinds type CES delayed-action plug receptacles are mounted on columns. Type EVF luminaires are suspended over tank port holes to light contents for inspection. Tank motors, and wall switches and junction box on rear wall, are all approved for Class I use.

# LIGHT ARMOUR PLANT

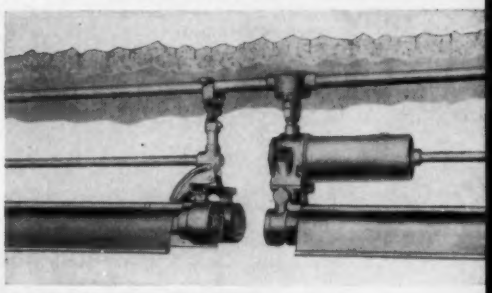


**HIGH BAY** area is lighted by continuous rows of 2 90-watt lamp explosion-proof fluorescent units mounted on 22-foot-high ceiling. Electrical control panelboard is in center foreground. Note eight plug receptacles (Crouse-Hinds types CES and CPS) on left end. These are equipped with delayed-action housings which prevent complete withdrawal of plugs in one movement. Plugs can only be removed from receptacles by withdrawing to a point where circuit is broken and the arc is snuffed in a flame-tight chamber, after which they may be withdrawn by a further twist of the plug.

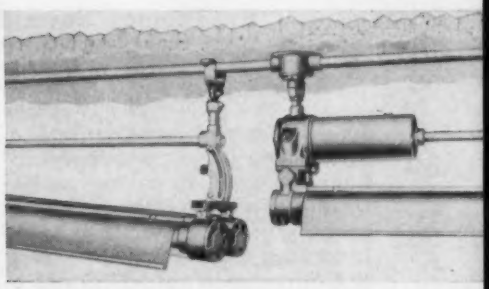


**THREE-LAMP** fluorescent luminaires of explosion-proof type light this Class I hazardous location, which uses flammable solvents to extract various types of powerful drugs. All electrical wiring, including switches, junction boxes, and plug receptacles, is also explosion-proof, as it weaves in and around the miles of complex piping connecting tanks, filter presses, centrifuges, ovens, condensers and stills at this pharmaceutical processing plant. Conduits and explosion-proof electrical fittings can be seen coming up out of floor in foreground of picture, at the base of the square tanks.

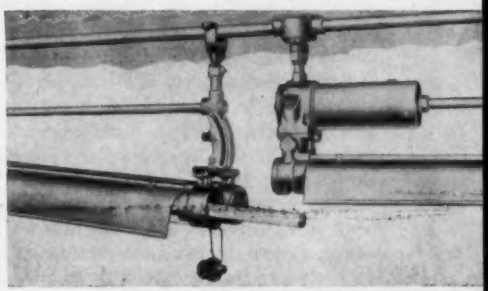
**RELAMPING SEQUENCE . . .**



Normal operating position, with two units mounted end-to-end . . .



End of one unit lowered for relamping, with link unlocked . . .



Cover of one lamp receptacle is removed, and lamp partly withdrawn.

*Contractors Make*

# Fork Truck a Versatile Construction Tool

**WORK PLATFORM** on fork-lift truck raises and positions bus duct sections for quick installation. Truck eliminates block and tackle and scaffolding; permits three-man crew to do work of five men in one-third less time.

**. . . . cuts man-hours on heavy equipment installation; eliminates rigging and scaffolding. Unit paid for itself on first two projects.**

**By Thomas Beveridge,** *Superintendent, Construction Division*
*Koontz-Wagner Electric Company, Inc., South Bend, Indiana*

IT TAKES fewer man-hours now to install heavy electrical equipment on projects handled by the Construction Division of Koontz-Wagner Electric Company, Inc., South Bend, Ind. Imagination and foresight on the part of K-W engineers has transformed a conventional fork-lift truck, normally considered a materials-handling device, into a versatile construction tool on electrical installations. The net result has been a reduction of some 40% in the size of specific crews. This permitted men released from one installation category to be effectively assigned to other work and led to more efficient use of a limited supply of available skilled manpower. On top of this, the smaller crews working on the lift truck were able to install bus duct, for example, in two-thirds of the time formerly required by the larger crews with the old techniques.

Koontz-Wagner's construction division (other departments include manufacturing, motor repair and engineering service) does an annual volume of about one million dollars—most of it in industrial plants. This involves the installation of heavy switchgear, transformers, bus duct, conduit and other types of raceways, much of which is frequently located on balconies, high on walls or near the roof trusses. Ladders, rolling scaffolds, rigging and block and tackle equipment were standard accessories used to work in high bay areas.

On previous jobs, a 5-man crew was needed to install conduit or bus duct in these locations. Two men worked on the scaffold, two men on the floor handled block and tackle to raise duct sections into place, and one man moved the scaffold and supplied materials. Like many contractors employing this technique, K-W faced a considerable amount of "non-productive" labor expended in assembling and disassembling scaffolding, rearranging and maneuvering scaffolds to meet building obstructions, and shifting block and tackle systems as the installation progressed.

In the fork lift truck, with platform attachment, K-W engineers saw an opportunity to eliminate much—if not all—of this "lost time". With the truck, they figured that a 3-man crew (two on the platform and one driving the truck) could replace the original 5-man crew on raceway installations. After careful study of this analysis, management felt justified in "risking" the investment of several thousand dollars on the purchase of a 2,000-pound capacity, gas-powered, Clark Yardlift truck. The new equipment paid off handsomely.

### *Truck Has Many Uses*

The original man-hour economy estimates were not only correct, they un-

**FORK LIFT** with one-man platform brings truss-mounted transformers within easy reach of mechanic who can work from almost any convenient height or angle. Platform is lowered when truck moves from one work area to another.

**ELECTRIC WINCH** on fork lift simplifies pulling cables through ceiling-height pull box. Truck anchors winch which can be raised or lowered to maintain proper pulling angle, or mounted on rear of unit for low-level pulls.

**FOR DIRECT PULL** requiring more power, truck is used as tractor. Fish cable is anchored to rear of truck which moves forward in a straight line. Diverting sheaves keep cable at proper pulling angle as truck moves away from wall.

derestimated the increase in overall installation efficiency. The three-man truck crew released two men for other important work. In addition, the maneuverability of the truck enabled this smaller crew to cut one-third off the installation time of the former 5-man crew. After cost-of-operation figures for the fork-lift truck were compiled, another startling fact came to light: the truck paid for itself on the first two jobs on which it was used.

Once the truck was on the job, numerous uses became apparent to the field engineers. To date, the unit has proved economical for the following installation phases:

*Duct and Conduit Work*—Unit combines an equipment "hoist" and work platform for two men. One man drives the truck. The platform, with a wood plank deck, is 7 feet long, 3 feet wide and has a 3-foot-high guard rail supported by eight angle-iron uprights. Steel channels on the underside of the deck seat the forks of the lift-truck. Maximum vertical lift of the unit is 11 feet. By adding a 7-foot high rack between fork and work platform, effective working height can be extended to 18 feet.

*Truss-Mounted Equipment*—Unit is used in same manner with a smaller 3-ft by 3-ft by 3-ft platform of similar construction. One man works on the platform, one drives the truck. It works exceptionally well for installation of dry-type transformers, control panels and similar items; also for overhead maintenance and repair work. Maneuverability of truck permits mechanic to work "around" the equipment from almost any angle. For safety reasons, the platforms are lowered when moving from one work area to another.

*Wire Pulling*—An ingenious electric motor-operated cable winch attaches to the fork lift for pulling cable through ceiling-height pull boxes. Winch can be raised or lowered to maintain proper pulling angle. Winch can be mounted to rear of truck for pulling at lower levels if desired. Or, the truck can be used as a tractor for direct pulling of heavy cables. Fish cable is attached to rear of truck and truck moves forward for pull. Proper pulling angle is maintained by deflecting cable with anchored sheaves. Biggest advantage is the fact that the truck acts as a substantial "anchor" for the cable winch and can be moved up to pull-box location even in the middle of an open area.

**BACK TO NORMAL** function as a materials-handling unit, fork truck transfers conduit to installation points. It is also used to slash time normally required to move transformers, cable reels, switchgear cubicles and other heavy equipment.

*Materials Handling*—When not used for installation chores, the truck works at its originally intended job—moving materials from storage to installation points. Detachable platforms and winches give way to the conventional fork lift. In this capacity it is used to transport reels of cable, bundles of conduit, sections of bus duct, motors, transformers, switchgear cubicles, groups of lighting fixtures and numerous other electrical equipment items. Time savings in this category can add up to a substantial figure.

The fork truck is transported from one job to another by a pick-up truck. The unit is either driven onto the pick-up from a loading platform, pulled on by a winch, or lifted on by a hoist.

While Koontz-Wagner engineers have developed these few "electrical construction attachments" for the fork-lift truck, the end is not yet in sight. Undoubtedly others will be added as future projects create other applications. For the operating philosophy of K-W's construction division is to have man-hours on the job spent on actual installation of an electrical system and not in moving a lot of rigging.

# FUSE TESTING

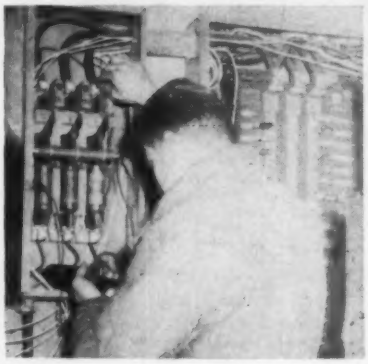
**By Walter J. Prise,**
Chief Engineer,
Queens Electric Motors, Inc., Jamaica, N. Y.

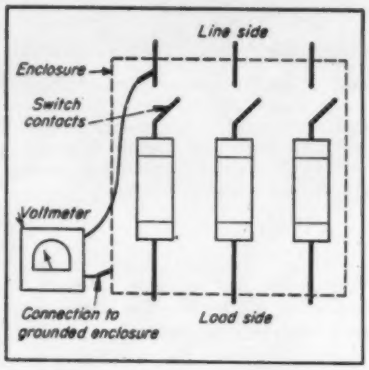
One of the most common causes of electrical trouble is a blown fuse. Although location of a blown fuse is relatively simple in some wiring systems, there are many cases in which an inexperienced person may have difficulty. In an extensive wiring system, identification of a blown fuse may often be a confusing proposition and consume an unjustified lenth of time. Because of the basic nature of the task, fuse testing should be reduced to a procedure of simple, conclusive steps, to minimize time involved and to maximize accuracy.

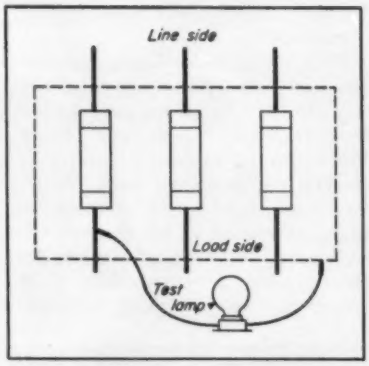
The following steps assure quick and accurate testing of fuses in a wide range of cases. Although they are not "bench" tests in themselves, they are closely associated with motor and electrical repair work.

## TEST 1.

**Testing for supply of power.** Before a suspected fuse is tested, the incoming power supply lines should be checked to make sure they are energized. Here, voltage readings are taken between ground (the enclosure is grounded) and the incoming supply conductors to a fused disconnect switch. A test lamp could also be used in this test, either from ground to hot lines (as shown here) or between hot lines. Switch is shown open. Incoming lines must be energized for the following tests in enclosure.





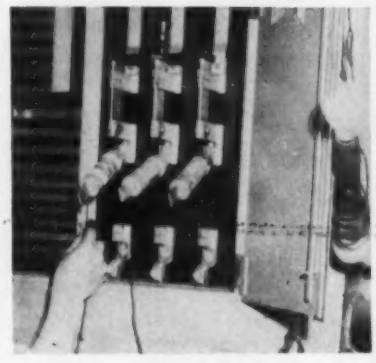



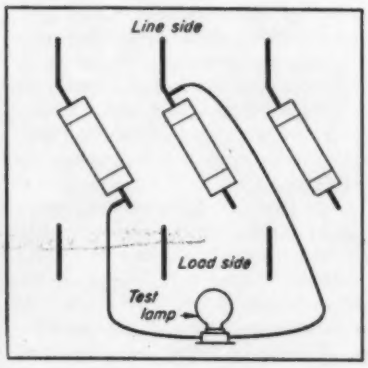

## TEST 2.

**Testing for open fuse link.** This test can be made with a test lamp or voltmeter. Supply line must be energized and switch closed. Place one probe on ground (the enclosure should be grounded) and the other probe on the load side clip of one fuse. Repeat this for each of the fuses. In the case of an open (blown) fuse, the test lamp will not light and a voltmeter will read zero. This test can also be made between pairs of load side fuse clips, in which cases indication of open fuse will be the same.

## TEST 3.

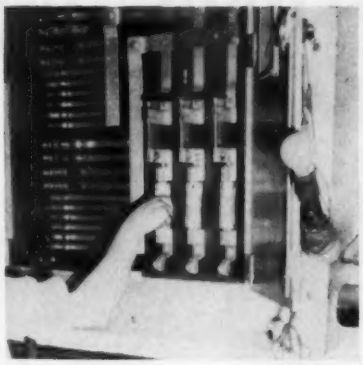
**Testing fuses with open load side.** In making the previous test with a test lamp or voltmeter there is a possibility of faulty test due to feedback through connected apparatus on the load side. Even with an open fuse, it is possible to have the lamp light or the meter register due to a circuit completed through connected apparatus. To eliminate this possibility, fuses are disconnected from their load side clips. Test can then be made by placing one probe on a disconnected fuse end and one probe on the line side of one of the other fuses (switch must be closed). This is repeated for each fuse. No light or reading indicates open fuse.

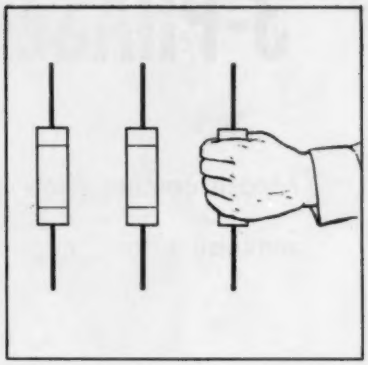


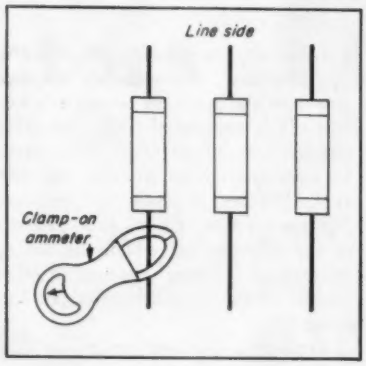


## TEST 4.

**Testing by touch method.** In some cases, although not too often, an open fuse can be detected by feeling the cartridge itself. Obvious difference in temperature may indicate a blown fuse. Other checks should be made to eliminate any doubt about whether a fuse is bad or not. The nature of the load should be considered when checking a fuse by touching it. This test is a quick, handy way to find a suspicious fuse without using tools or instruments.

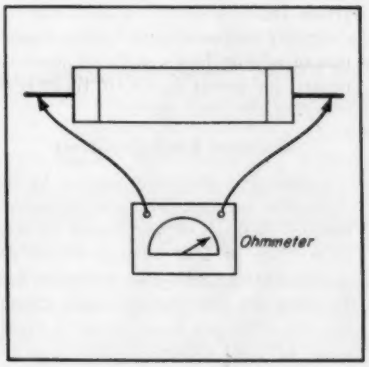






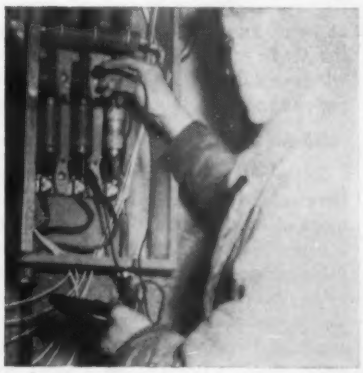

## TEST 5.

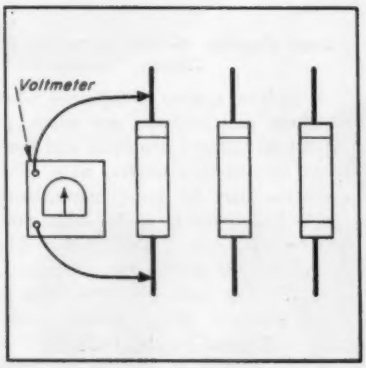
**Testing for blown fuse using the ammeter method.** A clamp-on ammeter can be used to determine if there is current flow through each of the phase conductors on the load side of the fuses to be tested. Zero reading on the instrument for one of the conductors indicates that the fuse may be blown ahead of that conductor, if the load is 3-phase or balanced single phases in equal use at the time. Again the nature of the load determines the validity of the test.




## TEST 6.

**Testing with an ohmmeter.** A simple way to test any fuse is to remove it from its clips and measure its resistance with an ohmmeter. An open or "infinite" reading indicates that the fuse is blown. A short or zero reading indicates that the fuse has continuity and is good.






## TEST 7.

**Testing by the "drop-of-potential" method.** When a fuse is blown there exists a difference in potential between its two ends. This potential drop can be detected by a low-reading voltmeter. In the case of a good fuse, this potential drop does not exist. This test can also be made with a neon lamp instead of a meter. The lamp will light in the case of a blown fuse.

# 3-PHASE LOADS UNBALANCED

## Measurements show the way to maximum load capacity.

**By A. L. Nylander**
*Instrument Department*
*General Electric Company*

**FIG. 1.** Hook-on volt-ammeter provides rapid measurement of currents in feeder lines and individual loads.

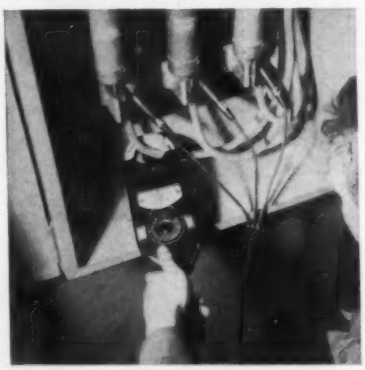


**FIG. 2.** Hook-on power-factor meter provides simple measurement of power factor and establishes proper phase sequence.

ELECTRIC power consumption has quintupled in the last 20 years. More important, it appears destined to continue to increase. This newer growth, however, tends to be in loads of low power factor resulting from increased use, for example, of fluorescent lights, air conditioners and induction motors. This circumstance focuses sharper attention upon the use of power lines and installations at their fullest capacity to afford the greatest return on investment. Certain simple measurements form the basis for determining the load arrangement which yields fullest capacity, a condition not generally realized by the present practice of adding loads, without adequate regard for power factor, to those lines carrying the least current.

### *Optimum Load Conditions*

Capacity is generally limited by the conductor current. This current causes heating through copper losses, as well as a drop in line voltage which reduces lighting and equipment efficiency. Because the line current limits capacity, the objective is to obtain a maximum of load kilowatts delivered for each line ampere.

This objective is reached in 3-phase circuits when two optimum operating conditions are obtained. First, loads must be balanced so that all lines carry approximately equal currents and there is practically no neutral current. Second, the power factor must be nearly unity. Not only does a high power factor release system capacity, but, in some instances where a pf penalty clause exists, it also saves dollars in power billing.

Before going into detailed procedure, it will be helpful if certain definitions and assumptions are reviewed. First of all, the term power factor is, by definition[1], the ratio of the real power to the apparent power in a circuit. It is associated with a so-called phase angle, or pf angle, that exists between the circuit voltage and current. For single phase and balanced 3-phase circuits, the pf is a measure of the efficiency at which the wiring installation is being used, or, in other words, of the load kilowatts per line ampere.

Because a 3-phase system is generally involved wherever electric power is used in any appreciable quantity, this discussion is limited to 3-phase circuits. These circuits are treated herein as wye connections only so that the line currents that are measured will be also the phase currents. Thus, even though these are actually delta loads, only their equally satisfactory equivalent wye loads are involved.

The assumption is made that the 3-phase voltages are in good balance, an assumption which is practical because basically our power systems have fixed voltage and variable currents as far as loads are concerned. Measurements, where they must be made on varying loads should be made at or near peak loads to get the limiting condition.

### *Load Capacity Release in Balanced Circuits*

A 3-phase system is balanced when its three line currents are equal, its three line voltages are equal and there is no current in a neutral wire. This condition may be most conveniently checked, by using a hook-on volt-ammeter, such as is illustrated in Fig. 1, to measure the currents and voltages. Such a balanced system has its three separate phase power factors alike and equal to the system pf, so that this system pf may be measured with a conventional 3-phase pf meter, or, more conveniently, with a hook-on pf meter[2] as illustrated in Fig. 2. If this pf is low and thus wasting needed system capacity, the amount of capacitor correction is easily read off from pf correction tables[4]. Capacitors at individual loads improve the pf in the feeders and release line capacity, whereas capacitors at the supply improve the pf for billing purposes only.

### *Unbalanced 3-Phase, 3-Wire Circuits*

In practice, 3-phase circuits may have closely balanced voltages but, more often than not, the line currents are unequal. The system is then unbalanced and the pf of the three separate phases are no longer alike. Also, the overall system or A.I.E.E. power factor differs from that of a balanced system and is covered by a more in-

[1] See Bibliography, Page 110

volved definition[1], the details of which are not necessary for this discussion.

It happens that available pf instruments measure the pf, with respect to the balanced voltage system, of the current in the single line chosen for the measurement without regard for the remaining two line power factors. Such a reading may be in error as shown by the single reading plot of Fig. 3.

With a slightly unbalanced 3-phase 3-wire system, this error may be largely eliminated, as shown in Fig. 3, by making three measurements, one involving each of the three line currents, and taking the average. For example, when the maximum and minimum line currents differ from one another by, say, 10% of the average line current, a single-line pf measurement may have as much as 0.05 power factor error, whereas the average of the three line pf readings is practically identical with the system power factor. In this case an average pf is sufficiently accurate for purposes of pf correction and operating information. Accuracy, however, falls off as the amount of unbalance increases.

With a moderately unbalanced circuit, where the maximum line currents differ from each other by about 20% of the average line current, the pf is obtained, as before, quite accurately as the average of the three line power factor readings. For example, with line currents of 90, 100 and 82 amps at power factors of 0.77, 0.64, and 0.62, respectively, the average and power factors are practically identical at 0.68. Such a system's load kilowatts capacity for the same maximum line current may be increased 32% by correcting the pf to 0.90 through the addition of a number of kilovars of capacitors equal to 60% of the number of load kilowatts. By balancing loads so that all currents are equal to the maximum line current at its power factor, the capacity gain rises to 38%. The gain from balancing the loads only is 5%. This shows that for moderate unbalance the average of three power factor readings provides the information necessary to determine the corrective capacitors to increase load capacity to somewhere near the practical maximum.

With severe unbalance, adding pf correcting capacitors as dictated by the average of the three line pf readings no longer brings the circuit up to optimum capacity. For example, with line currents of 50, 100 and 94 amps at 0.74, 0.85 and 0.46 power factor, respectively, the unbalance, or difference between maximum and minimum line currents in percent of the average line current, is 61. The average and power factors are still approximately equal at 0.68. Adding the same corrective capacitors as before to bring the pf up to 0.90 yields 14% capacity gain. Balancing the loads brings this gain up to 75%. Even without any power factor correction, merely balancing the load increases the capacity 53%. Thus, with considerable unbalance, the greatest release of load capacity comes generally from load balancing alone.

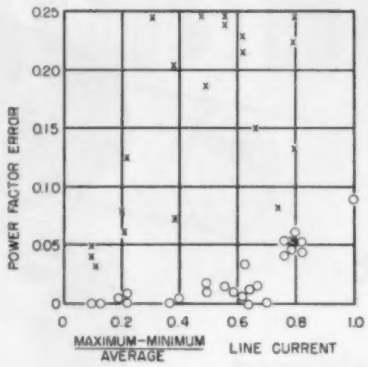



**FIG. 3.** Accuracy is improved by averaging the 3 separate line pf measurements when 3-phase 3-wire currents are moderately unbalanced. Here X indicates the maximum error of a single pf measurement at various current unbalances, while 0 is the error using the average of the three line pf measurements at various current unbalances.

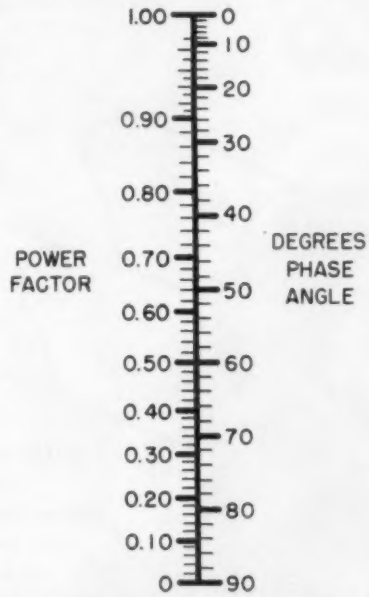



**FIG. 4.** Conversion nomogram for relating power factor to degrees of phase angle correction.

### *Effect of Unbalance on Power Factor*

It is significant to note that the systems in these two examples operate at the same maximum line current and power factor. Yet they operate at only 90% and 81% respectively of the kilowatt load of a balanced system operating at the same maximum current and power factor. Therefore, with unbalance the pf is no longer the usual measure of load efficiency.

This fact points the way to a different approach, one made practical by the convenience of the hook-on pf meter and volt-ammeter. The concept of a system pf is replaced by the concept of each of the three lines operating at a definite and measurable pf of its own. By measuring the pf and the amps of each of the three lines, and by checking the line voltages for balance, all of the operating conditions of a 3-phase 3-wire unbalanced system become known. Steps can next be taken to balance the system and, if justified, improve the power factor.

### *Balancing the 3-Phase, 3-Wire System*

To balance the system, a single phase load must be added across two lines. Determination of the amps and pf of this load and the two proper lines is shown in Fig. 5. The three measured line currents, identified in direct phase sequence A-B-C, are drawn on a polar coordinate plot at their respective power factor angle degrees away from their phase voltages $V_A$, $V_B$ and $V_C$ and with radial lengths equal to their amps. For convenience, pf may be converted into degrees by using a nomogram similar to Fig. 4. A lagging angle is taken clockwise from its voltage while a leading angle is taken counterclockwise.

To determine the balancing load:

1. Take the pf angle of the largest current, ($I_B$ in Fig. 5), and measure off this angle from each of the remaining 2-phase voltages ($V_A$, $V_C$).

2. Draw a radial line at each of these two angles equal in length to the maximum current.

3. Join the ends of the new current line and the original current line for both phases, (lines $I_A$-$I'_A$ and $I_C$-$I'_C$).

4. The amps of the balancing load is the length of either of these equal joining lines.

5. The pf angle of the balancing load is the angle, 90 degrees or less, that these joining lines make with the line voltage across these two phases, $V_{CA}$, to which the load must be applied.

In the example the balancing load

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## 3-Phase Loads

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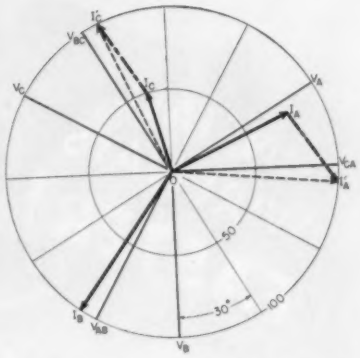

**FIG. 5.** Graphical construction shows how to add a single phase line to load to balance any 3-phase 3-wire unbalanced load current system.

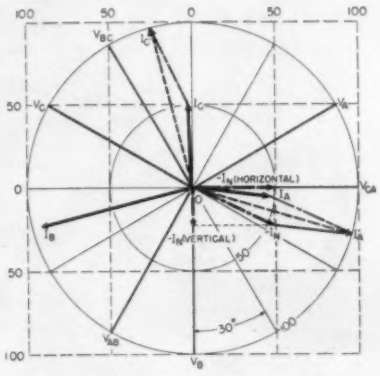

**FIG. 6.** Addition of single phase line to neutral load, $-I_N$, to cancel any 3-phase 4-wire neutral current. The result is an equivalent 3-phase 3-wire unbalanced system, shown in turn balanced by a single phase, line to line load $I_cI'_c$.

is 52 amps at 0.55 lagging power factor. This load, of course, is ideal and practically there will seldom be a load of just this magnitude and pf to apply. It does, however, indicate the desired load and may be approximated when adding new loads. In Fig. 5, balancing increases the kw capacity 25%, while capacitor correction to 0.90 pf increases this gain to 34%.

### *Plotting Load Growth*

The Fig. 5 diagram may be used to find the result of adding any load simply by drawing it in from the center at the known amps length and pf angle from the voltage across which it is to be applied. This added load current is combined with the original line current by graphically completing the parallelogram of which these two currents are adjacent sides. The diagonal of the resulting parallelogram from the center of the plot provides

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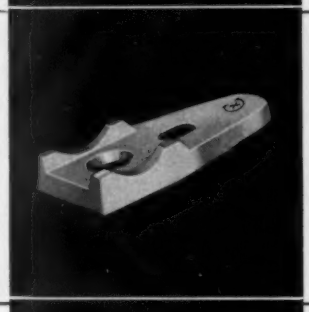

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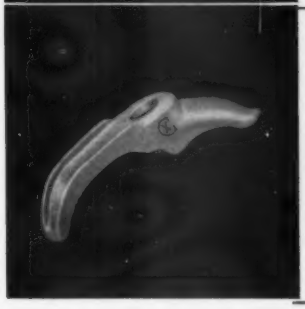

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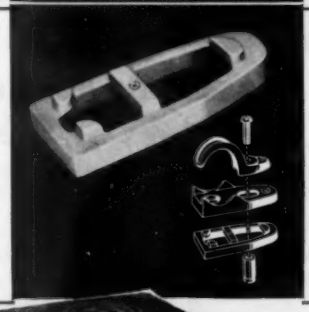

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## 3-Phase Loads

. . . *Starts on page 102*

the amps and phase angle of the total current in this line. If the added load is single phase, an equal and opposite line, such as $I_cI'_c$ in Fig. 5, must also be drawn and combined with the second of the two phases across which the load is applied. In the case of adding a 3-phase load, three current lines will have to be added, each at the load pf angle from its respective phase voltage $V_AV_B$ and $V_C$.

To correctly add balancing loads all line wires must be identified A-B-C in direct sequence at all load points. Once done, this identification needs no replacing.

### *Balancing 3-Phase, 4-Wire Circuits*

When the unbalanced system is 3-phase 4-wire, there is generally a current in the neutral wire. This neutral current must be eliminated in order to reduce the system to a 3-phase 3-wire equivalent which is treated from there on as already discussed in connection with Fig. 5. To eliminate this neutral current the Fig. 6 construction is used.

1. Check the voltages for balance and measure the currents in the three identified lines.

2. Measure pf on each of the three lines (no measurement on the neutral wire).

3. Plot the three line currents $I_A$, $I_B$ and $I_C$ at their pf angles from their respective phase voltages.

4. Find the neutral balancing load amps and location on the Fig. 6 plot by algebraically adding the horizontal components of the three line currents and drawing their sum on the plot in the *opposite* direction, then doing the same for the three vertical components. The diagonal $-I_N$, of the rectangle with these two components as adjacent sides is the amp line to neutral load needed. This load is added between neutral and whichever line ($V_A$ in this example) is within 90 degrees of this diagonal.

The neutral current is thereby cancelled. This added load, $-I_N$, transforms line A current to $I'_A$ by the parallelagram construction of addition shown. The line currents $I'_A$, $I_B$ and $I_C$ are now an equivalent 3-phase 3-wire system whose balancing line-to-line load is determined using the procedure followed for Fig. 5.

For the Fig. 6 example the line to neutral load to be added is 54 amps at 0.58 pf lag connected from line A to neutral. This load yields a 28% in-

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## 3-Phase Loads

. . . *Starts on page 102*

crease in kw capacity, and the balancing line to line load of 50 amps at unity pf across $V_{BC}$ ups this to 120%. If capacitors are added to correct the power factor to 0.90, the overall kw capacity increase is 186%.

The improvement in kw load capacity due to any change in load, may be calculated by comparing the "before" and "after" products of (1) the phase voltage, (or the line voltage divided by $\sqrt{3}$), and (2) the sum of the three products of each line current and its power factor. Once balance is established the kw capacity increase due to power factor correction is in the ratio of the corrected to the original power factor. A more direct method of finding the load kilowatts under various circuit loading and pf conditions is to make actual measurements using, for example, a hook-on wattmeter[3].

### *A Perpetual Load Inventory*

For any 3-phase electric circuit, therefore, whether currents are balanced or unbalanced, means are available for making and plotting simple measurements to provide "at-a-glance" information as to line currents and phase power factors. These plots show where to add new loads to improve balance and obtain better line utilization. When loads are added or transferred, they can be drawn in on the plots and new resultant currents obtained, thus providing a continuous picture of operating conditions. These plots may be verified periodically by taking a "physical inventory" in the form of periodic measurements. Such measurements are most conveniently and simply made with instruments of the hook-on type, because of their unusually wide measurement range and because they involve no interruption of power.

These simple measurements form the basis for determining the load arrangement which yields fullest capacity of power lines.

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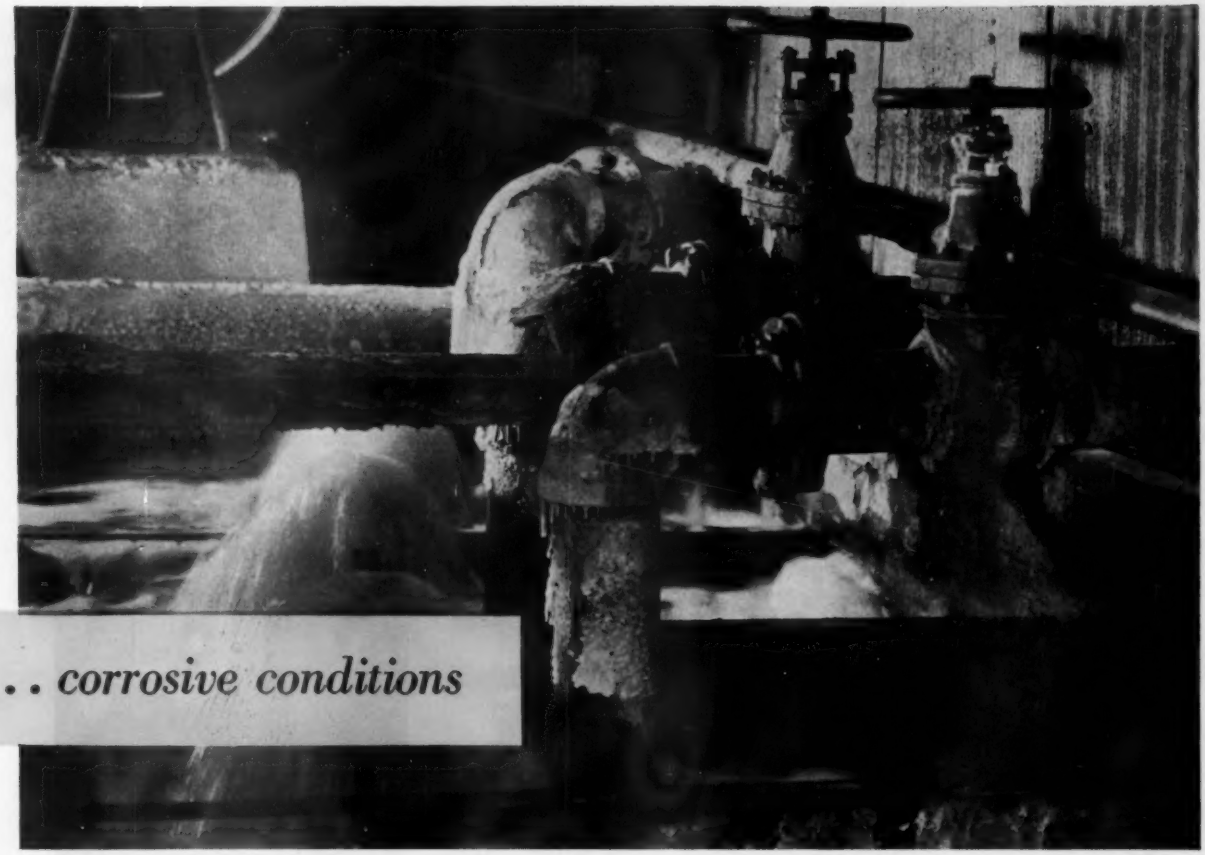

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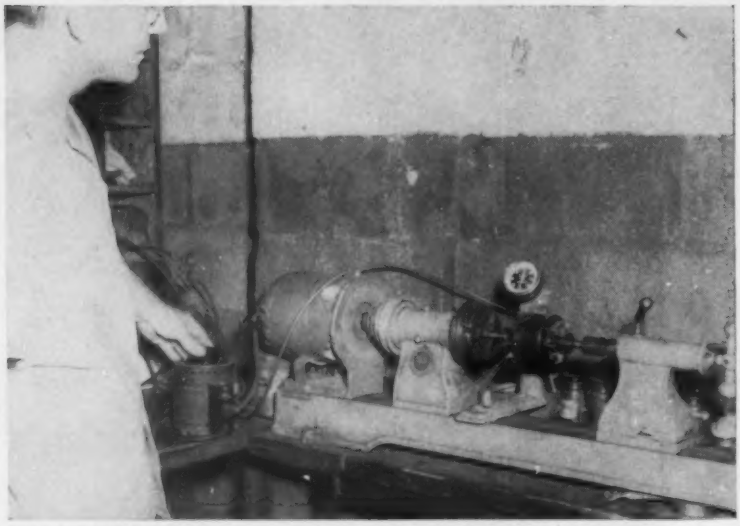

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A small bench lathe, driven by an adjustable speed motor that can run at graduated speeds from zero to 7000 rpm, is used in the shop of the Standard Electric Motor Repair, Linden, N. J., to check centrifugal cutout switches before they are actually installed as overspeed protection devices. Since a tachometer is also coupled in this test assembly unit, it is possible to accurately determine the speed at which the cutout device operates. Motor speeds are controlled by means of a manually operated control drum. By checking throw-out speeds before centrifugal switches are actually installed, later disassembly and replacement is avoided and rotational operation can be positively guaranteed.

## V-Shaped Dip Tank Proves Economical

A unique V-shaped dip tank is doing a better varnish impregnating job on motors repaired at the Miller-Seldon Electric Company in Detroit. The reason for this, according to repair department manager, C. R. Medsker, is that the varnish is kept in proper condition because the amount in the tank is more in ratio to the amount used. No substantial amount of excess varnish remains in corners, as with rectangular tanks, and there is no need to add thinner or agitate the solution.

Medsker's tank is 36-in. deep at the center point, 47-in. wide and 76-in. long. It is constructed of ½-in. steel boiler plate with a 2-in. channel-iron lip at the top to seat the hinged drop-cover. The V-shaped bottom consists of two sheets of ½-in. boiler plate at right angles welded to the tank sides. Ample drain facilities are added.

Based on 7½ gallons of varnish per cubic foot, the tank has the following capacities at the listed varnish levels:

| | |
|---|---|
| 36-in. (full depth) | 236 gallons |
| 30-in. | 168 gallons |
| 24-in. (¾-depth) | 105 gallons |
| 18-in. (½-depth) | 59 gallons |
| 10-in. | 18 gallons |

Another unique feature of the tank design is the self-contained counterweight arrangement on the hinged cover. Two heavy coil springs are mounted in inverted V fashion to brackets at the base of the tank. The counterweight cable is attached to the point of the V and runs over a pulley at the top of a vertical bracket to the tank cover. When the cover is closed, the cable elongates the two springs. At this point, tension on the springs is greatest. If the cover is lifted slightly, the springs take over, pull the lid up and hold it in a vertical position. At this point the two springs are almost back to normal length and they assume the shape of a very flat V.

The counterweight cable is attached to the tank cover by means of a parrot-jaw clamp. One jaw lever extends through the cover and is connected by a fuse link to a hook-bolt on the underside. Should a fire occur, the fuse link will melt and free the lever. The parrot jaws open releasing the counterweight cable, and the cover drops down to smother the flames in the tank. An angle-iron flange around the underside of the cover serves the double purpose of adding rigidity and forming an effective air seal when cover is closed.

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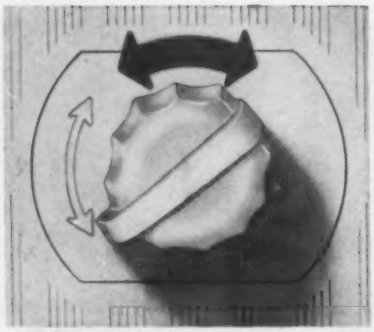

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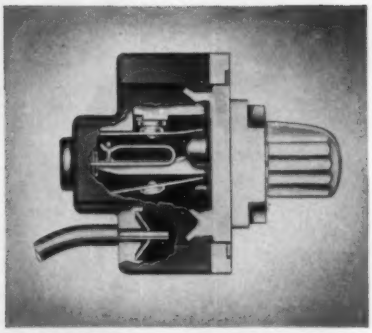

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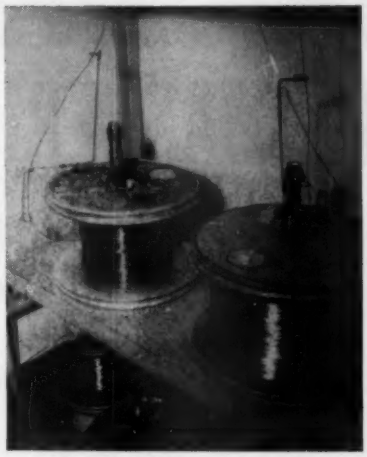
## Wire Storage Shelves Have De-reeling Unit

A tier of shelves with de-reeling devices provides magnet wire storage and pay-out facilities in the coil winding department at Ross Electric Motor Shop in Fairmont, Minn. Owner Frank Ross designed the combination unit to eliminate unnecessary handling of popular size wire reels and permit unhampered de-reeling of the wire onto the winding machines within a limited floor area.

The three-shelf rack actually occupies about six square feet of floor space and is located directly behind the winding heads. It is 49 inches long, 17 inches deep and 7-ft, 3-in. high. Uprights and shelf supports are fabricated from pieces of 1½-in. angle iron. The first of the three wood shelves is about 6 inches above floor level. Space between the others measures about 27 inches. Each shelf accommodates three 12-in. diameter magnet wire reels lying on their sides and spaced so the de-reeling mechanism will rotate freely around each reel.

At each reel position, the wire pay-out device consists of two basic parts. A short length of ½-in. pipe, with a floor-flange base extends up through the reel. The upper portion of this "axle" is machined to accommodate a bronze bushing fitted inside a short ¾-in. pipe sleeve which has a small set-screw collar welded to its side. This set-screw mounting positions and securely holds the wire de-reeling arm. The complete assembly slips over the pipe support and is free to rotate around the reel under slight braking pressure supplied by a coil spring positioned between the sleeve and a stop-collar at the top of the support. Pressure can be easily adjusted by raising or lowering the stop-collar to release or compress the spring coils.

**COMBINATION STORAGE** and de-reeling rack takes about six square feet of floor space, holds nine 12-in. diameter reels with magnet wire ranging in size from No. 15 through No. 23. Unit is located directly behind oil winding machines.



**DE-REELING DEVICE** rotates around center-post at each reel position, has coil-spring braking mechanism, keeps wire from snagging on reel and provides required vertical pull through guide bracket above.

The de-reeling arm is made of two sections of gas welding rod. The lower section has a right angle offset plus a vertical and horizontal eye through which the wire is threaded. This unit is fastened to the set-screw collar and keeps the wire from snagging on the reel as it rotates. The second section, welded to the first to form a vertical guide with a horizontal eye at the top, assures an upward pull as the wire comes off the reel. Wire from each reel forms a right-angle sweep to the winding machines by passing through holes in a wood bracket above the reels and through discarded ball bearings welded to the underside of the shelf support directly above.

Prime design consideration when building a unit like this, according to Ross, is to have a de-reeling arm that safely clears the reel as it rotates, provides a straight-up pull, and incorporates some means of controlling the tendency to "free-wheel" as the wire is unwound.

## Re-reel Unit Spools Wire from Large Reels

To accommodate the small-motor coil winding operation at Shakstad Electric & Machine Works, Sioux Falls, S. D., magnet wire is supplied to the department on small 6-in. diameter spools. Instead of purchasing wire on small spools, Shakstad buys the large 12-in. diameter reels for stock and re-spools it as needed by the small motor section.

Re-reeling on small spools is done in a matter of minutes on a machine designed specifically for that purpose. The unit, located on a wire storage balcony, has an angle-iron (1½-in. stock) frame 33-in. high, 24-in. wide, and 29½-in. long. A single, constant-speed, fractional horsepower motor drives the re-reeling mechanism through a series of counter-shafts, bearing-supported by old motor-frame shells.

The large reel of wire is mounted to a free shaft near the base of the frame. This shaft is equipped with a friction-type wheel brake, controlled by a coil spring, to provide a measure of winding tension and prevent "free-wheeling" of the reel during the re-spooling

**RE-SPOOLING UNIT** in wire storage balcony transfers magnet wire from standard stock-size reels to smaller spools for use in coil winding department of the small motor repair section. Mechanic can wind a 6-in. diameter spool in a matter of minutes.

**COUNTER-SHAFTS** permit single motor to drive entire re-reel mechanism. Wire leaves brake-controlled large reel (lower left), passes under idler pulley and through fibre guide "fingers" to re-wind spool at top of frame (upper right).

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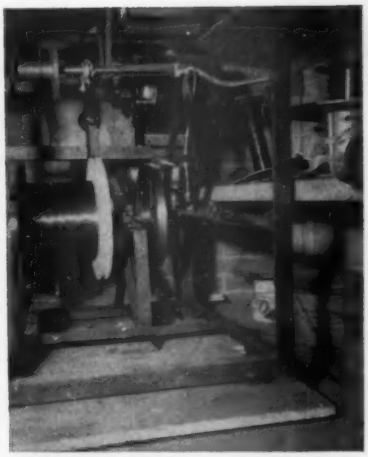


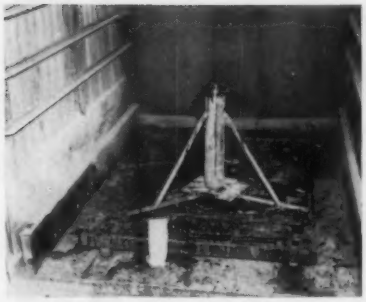
**FRICTION BRAKE** on free shaft provides rewinding tension and prevents large wire reel from "free-wheeling" with resultant wire snagging when machine is in operation. Brake arm has coil-spring control and shaft extension for idler pulley.

operation. A shaft extension of the brake arm supports a 4½-in. diameter empty spool which acts as an idler pulley. As the wire leaves the large reel, it passes under this pulley on its way to the re-reel spool mounted on a shaft at the top of the frame. A V-belt drive, on step-type cone pulleys, connects the spool shaft with an intermediate counter-shaft and permits changes in rewind speed. The counter-shaft has a direct V-belt connection to the driving motor.

Additional control of the re-spooling operation is provided by a fibre-tipped guide arm pivoted to the top of the frame. The wire passes through a long slit in the arm just before it goes on the spool. While the machine is running, the mechanic moves this arm back and forth laterally to guide the re-wound wire across the spool drum. This assures side-by-side alignment of the magnet wire on the spool, prevents bunching, and eliminates the possibility of snagging when the wire is de-reeled at the winding machine.

## Pipe Stand Supports Large Armatures

When baking large armatures, Industrial Electric Company of York, Pa., employs a pipe stand of simple construction to support the units in the center of the oven. The pipe is of 3-inch stock, 18 inches in length, welded in an upright position to a square metal base plate, and prevented from tipping by means of three base extensions and tripod supporting channels. This stand may be placed on a rolling dolly so that armatures may be



**TRIPOD-BRACED** pipe stand on metal base plate holds large armatures in upright position for baking.

placed in position outside of the oven, then rolled into the heating zone. This stand is used only for armatures of large dimensions, at which times the armature is tipped so that the shaft is in a vertical position and can then slip inside of the pipe.

## Spring Tension Checked by Scale

Each make of speed-governing device is designed to operate against a definite spring tension, yet springs can and frequently do vary so that the tension characteristics are not constant. If cutouts are to operate at predetermined speeds, however, these inconsistencies must be detected and compensated for, and it is for that reason that the Standard Electric Motor Repair organization of Linden, N. J., uses a calibrated checking device.

The device is mounted on a compact base plate (8 by 4 inches) and consists essentially of two hooks, one at the top

**WEIGHTED LEVER** applies tension to spring while pointer revolves to show exact distention under known forces. By matching spring tension to designed characteristics of governor, operational safety can be maintained at its original level.

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of a movable bar and the other at the inside end of a pivoted arm. The pivoted arm also has an extending lever, over which weights can be slipped, and a calibrated scale to register the distance that the related hook moves during the checking process.

To check the tension of a spring, the spring loops are placed over the hooks. The movable bar is slipped along the base bar until the spring is tight without being tensed, then the movable bar is clamped by means of a small thumb screw. A known weight is then placed on the end of the extended lever arm and, as the spring is tensed and the pointer of the scale moves downwards, the tension of the spring is accurately indicated. Knowing the proper tension for each device, then selecting a spring which meets the proper combination of weights and scale reading, the cutout speed of the governor can be accurately maintained, thereby providing the safety for which the governor was originally planned.

## Clip-Stand Holds Reference Data

A 9-by-12-in. metal sheet with a standard clip at one end is used in the shop of Berks Engineering Company in Reading, Pa., to hold data sheets for recording or reference purposes. With the metal backing sheet welded to a 15-in. length of pipe, and with this pipe capped at either end with 5-in. square plates, the clip board may be held vertically for convenient viewing, or rested horizontally on a bench or desk for convenient writing.

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**SQUARE END CAPS** on either extremity of a 15-in. pipe-stand makes it possible to either place the assembly upright or rest it on its side, permitting either vertical or horizontal use for viewing or recording purposes.

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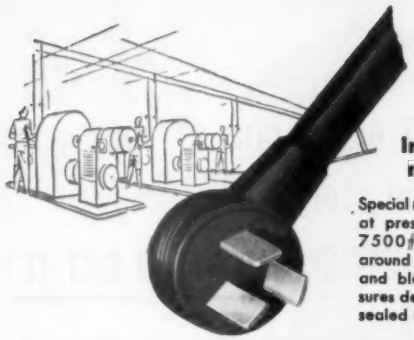

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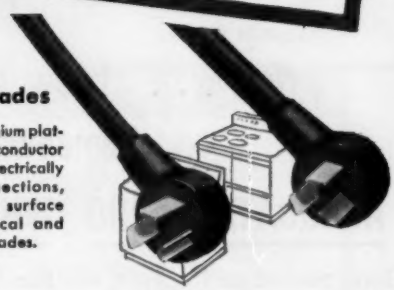

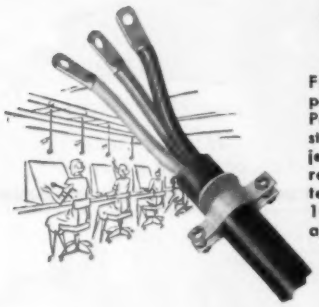

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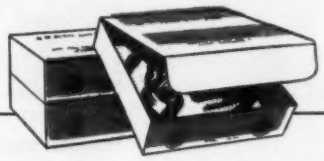

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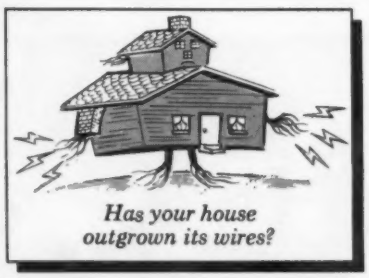

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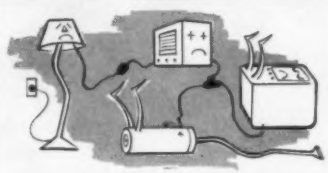

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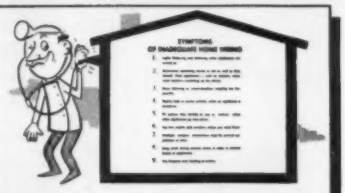

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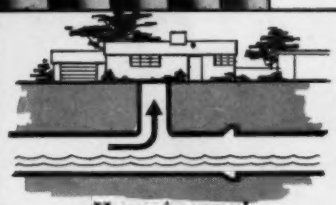

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# Modern Lighting

## Exterior Lighting Builds Sales Interest

Jack and Jill Corner, a children's apparel shop in Philadelphia, Pa., uses exterior lighting to point up the tasteful simplicity of its architectural design and to arouse the interest of passers-by. Located in a poorly lighted neighborhood, the bright store front attracts attention without destroying the primarily residential character of its surroundings.

Contractor Jack Adler, who designed the installation, achieved this effect by installing recessed high-hat units in the soffit of the 3-ft wide overhang that runs around the three exposed sides of the building. Fixtures are spaced on approximately 3½-ft centers along the front of the store to emphasize this facade and direct attention to the display windows. At the sides, the spacing is about six feet, since the primary function of these units is to bring out the style and conformation of the structure. Litecraft 1001 high-hats with 150-watt R-40 floods were employed for the installation.

Window lighting is obtained from 30 silvered-bowl reflector units which are concealed behind a deep window valance. The intensity of illumination in the windows is high in relation to that of the exterior lighting so that the focus of interest is kept on the display.

For the interior of the shop, which is narrow and low-ceilinged, Adler installed three Smithcraft "Director" 4-light, 96-in. luminaires mounted continuously and lamped with deluxe cool white slimlines for accurate color reproduction of the merchandise. These "Director" series fixtures were selected because their unusual width tends to counteract the restrictive appearance of the shop's dimensions.

Show window and exterior lighting is controlled by a magnetic contactor which is actuated by a time clock. Additional weatherproof outlets were provided on the outside of the building for special holiday displays.

## Bank Remodels with Custom-Built Fixtures

A 4-fold increase in illumination, a major boost in usable floor area, improved employee efficiencies and complete customer satisfaction were achieved objectives in the Mellon National Bank and Trust Company of Pittsburgh, Pa., where the Frame Electric Company worked closely with architects on the modernization program. Prior to this program, the bank was a dimly lighted, high-ceilinged, ornately fixtured monument to staid banking tradition—a far cry from the bright, trim, modern place of business that it is since alterations were completed. To those familiar with the before-and-after appearances, the transition is startling, and opinion is unanimous that lighting made the largest contribution to this efficient new look.

No changes whatever were made to the basic floor plan, but the original heavy bronze lanterns were eliminated when the 30-ft-high ceiling was lowered to a 14-ft level, and tellers' cages gave way to streamlined glass-topped parapets. By lowering the ceiling from its former 2-story height to the mezzanine point, a complete additional floor could be constructed for general office usage, and replacing the bronze lanterns with custom-built fluorescent luminaires stepped footcandle intensi-

**CORRUGATED PLEXIGLAS** and plastic panels shield 16 deluxe cool white fluorescent lamps in each 8-by-8-ft recessed luminaire in this remodeled bank where illumination was boosted from 12 to 55 footcandles. Lighting plan was conjunctionally developed by electrical contractor and architect.

ties on work surfaces from 12 to 55.

These specially-designed fixtures were made by the Frink Corporation, with 16 T-12 cool white deluxe bi-pin 40-watt lamps in each 8-by-8-ft unit. The fixtures are completely recessed in the acoustical tile ceiling, and lamps are shielded by corrugated Plexiglas and plastic panels supported by aluminum T-bar framework. Panels are ⅛-in. thick with corrugations spaced on 1-in. intervals, while the 18-gauge steel housings are finished in white enamel.

In creating the fixture layout it was necessary to consider the placement of columns, structural floor beams and air-conditioning ducts, yet the resulting pattern gives no indication of this juggling. Another commendable feature of the installation is the provision for 2-level illumination, for each fixture is wired to two separate 110-volt circuits, with alternate lamps staggered between these two branches.

The overall installation consists of 22 fixtures, represents a connected electrical load of 14 kw and provides illumination to a 5760-sq-ft area. And the overall impression is one of modern conservatism, with luminaires giving the feeling of a skylighted plaza, and with adequate illumination creating the illusion of greater height and breadth than actually exists.

## In-Built Lighting Promotes Sales

Merchandise is displayed with maximum sales appeal in Luria's Liquor Store, New York City, where lighting intensities range from 40 up to 90 footcandles and where several different lighting mediums are utilized in an interesting ceiling pattern.

Basically the ceiling consists of a dropped central panel with six upturned lighting troughs extending outwards on either side to the walls. These troughs give the appearance of beams, yet each one shields two 8-ft T-12 cool white slimline lamps that reflect light from the flat white ceiling, resulting in an overall counter-top intensity of 40 footcandles throughout the store.

In the center of the store beneath the dropped ceiling panel, intensities are 90 fc, provided from four 2-lamp recessed ribbed-glass fixtures, plus half a dozen recessed 150-watt R-40 floodlamps. These accommodate the central bottle island display.

Around the entire perimeter of the store, directly over and adjacent to wall shelves, are recessed Neo-Ray units containing 40-watt T-12 cool white lamps, while similar lamps shielded by frosted glass bottom panels surround the "Little Bottle Section" that encloses a large structural column located at the center of the rear wall. From these various perimeter treatments, intensities of from 70 (at top) to 40 (at bottom) footcandles are delivered to the vertical plane for easy identification and effective presentation of bottled products.

**90 FOOTCANDLES** are delivered to central bottle island from recessed floodlamps and glass-panelled fluorescent units in dropped ceiling panel. False beams and perimeter valances shield additional lighting sources for overall illumination in this liquor store.

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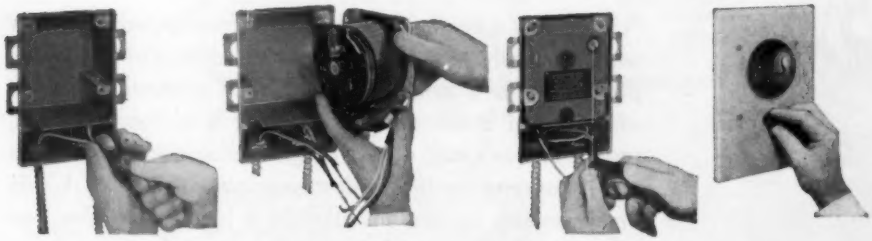
LUXTROL Light Control is an entirely new idea in modern home lighting. It's an *auto-transformer-type* light control. It gives to home owners, for the very first time, any level of light from dark to full-bright... the perfect level of light for every activity. And it controls not only incandescent lighting but fluorescent and cold-cathode, too.

A soundly engineered, compact autotransformer unit — with brush and winding in constant contact and both fuse and thermal overload protection — LUXTROL operates smoothly, silently, safely... never needs service... is approved by Underwriters' Laboratories.

Best of all, LUXTROL requires no complex wiring. It's as easy to install as an ordinary wallswitch!

**You'll soon be getting calls for this completely new kind of home light control. So make a date *now* for a personal demonstration. Call Western Union Operator 25 in your own city and ask for the name of your LUXTROL distributor.**



New LUXTROL Light Control is as easy to install as an ordinary wallswitch!

**THE SUPERIOR ELECTRIC COMPANY**
**6035 Demers Ave., Bristol, Conn.**

**Please send me full technical data on new LUXTROL Light Control.**

**NAME**_____

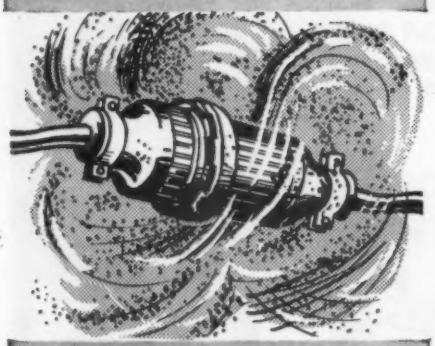
**STREET**_____

**CITY**_____ **ZONE**____ **STATE**_____

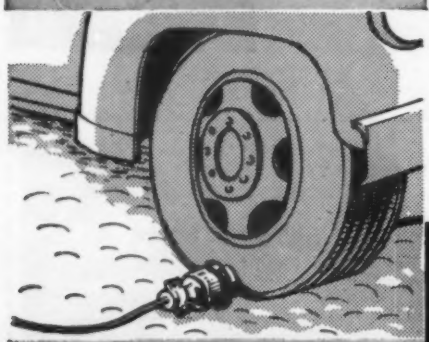
# This trade-mark identifies

# ...the most remarkable *New* connector

it seals out moisture!



it seals out dirt!



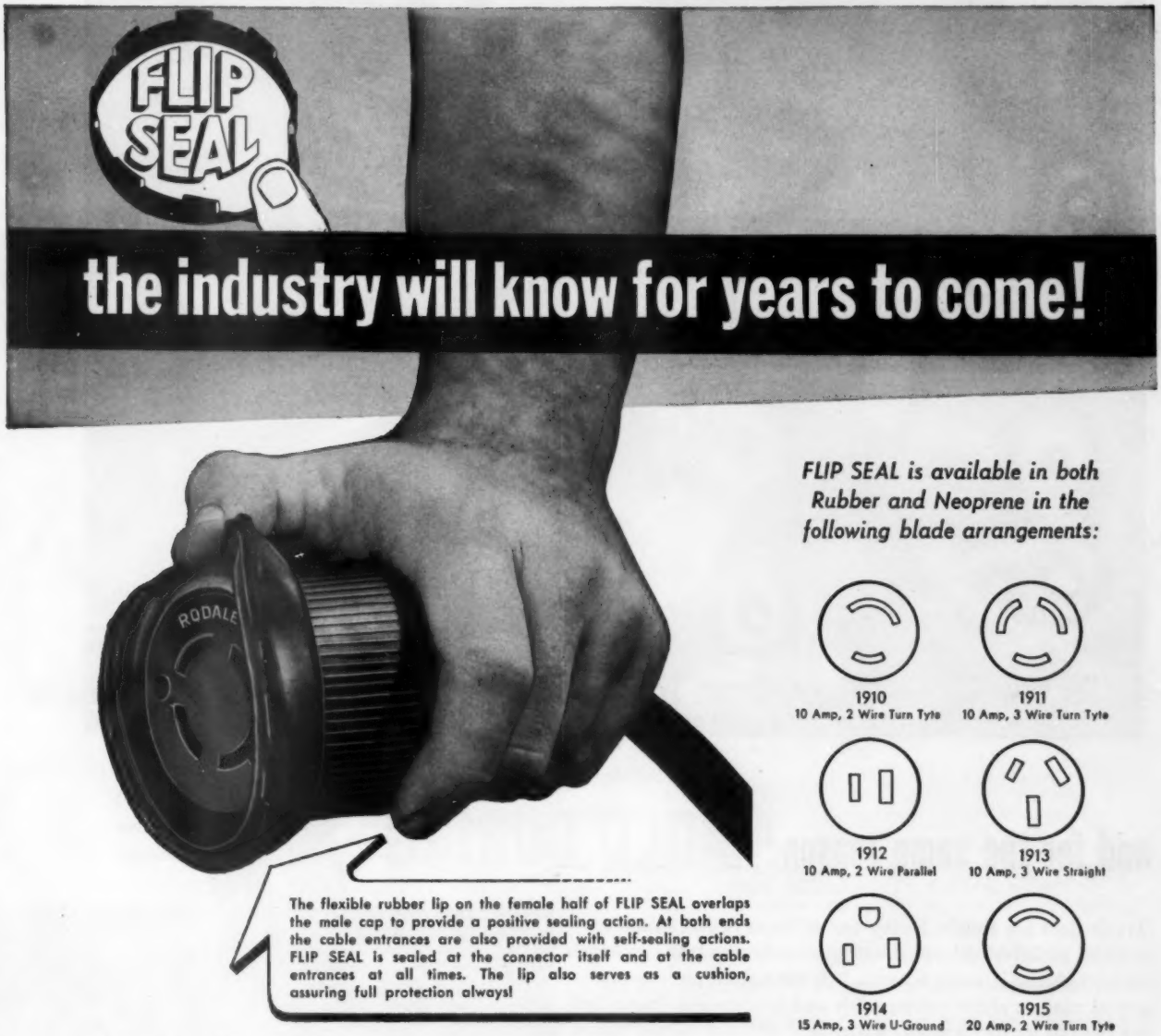
it offers you protection never before possible!

FLIP SEAL, Rodale's brand-new concept in the field of electrical wiring devices brings you features never before possible in any connector!

FLIP SEAL is a heavy-duty, ruggedly-constructed connector which instantly seals out all moisture, dust, dirt and metal particles — and brings you *cushioned protection* against all forms of shock and accidents! It is a complete unit, ready for quick and easy wiring, available in both rubber and neoprene in the widest possible variety of blade arrangements for *any* installation! It is tested to give you guaranteed superior service on any type of job.

FLIP SEAL is priced for the mass market. It is priced so that every portable connector can now be replaced with a FLIP SEAL connector and offer greater protection and greater savings in time and money. FLIP SEAL eliminates

FLIP SEAL is an entirely new principle in wiring device and part of the line of more than 600 wiring devices for home, industry and community manufactured by ...




# the industry will know for years to come!

The flexible rubber lip on the female half of FLIP SEAL overlaps the male cap to provide a positive sealing action. At both ends the cable entrances are also provided with self-sealing actions. FLIP SEAL is sealed at the connector itself and at the cable entrances at all times. The lip also serves as a cushion, assuring full protection always!

the cost and loss of time that occurs when a faulty, broken connector must be replaced.

Test FLIP SEAL yourself. Subject this amazing connector to the most extreme tests of abuse — it can be run over with a truck, dropped from a great height, stepped on, submerged in water — and it will continue to do its job!

**Investigate the innumerable possibilities of this new, low-priced weatherproof connector and you'll start to specify Rodale's FLIP-SEAL**

Pat. App. For

*FLIP SEAL is available in both Rubber and Neoprene in the following blade arrangements:*



1910
10 Amp, 2 Wire Turn Tyte

1911
10 Amp, 3 Wire Turn Tyte

1912
10 Amp, 2 Wire Parallel

1913
10 Amp, 3 Wire Straight

1914
15 Amp, 3 Wire U-Ground

1915
20 Amp, 2 Wire Turn Tyte

1916
20 Amp, 3 Wire Turn Tyte

1917
20 Amp, 2 Wire T-Polarity

1918
20 Amp, 3 Wire Straight

1919
20 Amp, 4 Wire Turn Tyte

**Rodale** MANUFACTURING CO., Inc. · EMMAUS, PA.

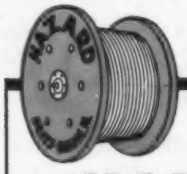
Warehouses in Chicago & Los Angeles
Representatives in all Principal Cities
Selling Exclusively Through the Electrical Jobber


## and for the same reason: MOLD CURING

Truck tires are tough. Every one of them is vulcanized in a metal mold—mold-cured—to guarantee the brute strength and toughness it must have to lick the rutted pavements, gravel roads, rubber-eating skids and tremendous loads that are part of its day's work. Thorough, uniform curing makes the tire a uniformly rugged "shoe" incorporating the strength of all the individual components.

Hazacord cables are tough, too. Every foot of every tiny flexible cord or heavy high-voltage cable is mold-cured to give service-proved "truck-tire" toughness and durability. Even, thorough curing guarantees a strong, compact cable assembly that adds to the remarkable strength of its components yet retains maximum workability and flexibility. This long-lived construction has made Hazacord the solution to difficult installations where other portable cables have failed after relatively short operating periods.

For any type of portable power distribution in industry, mines or utilities there is a tough Hazacord construction that is best for the job. Ask your jobber or your nearest Hazard representative for details or write for Bulletin H-451, Hazard Insulated Wire Works, Division of The Okonite Company, Passaic, N. J.




2135

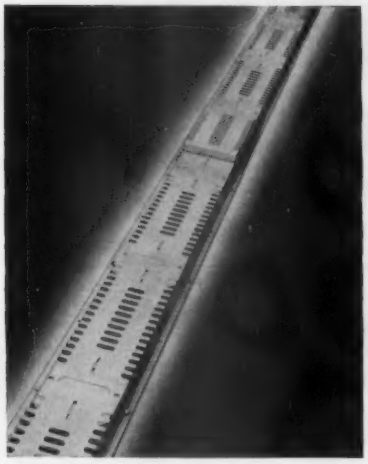
**HAZACORD**

*Mold-Cured*

**portable cables**

PRODUCT OF OKONITE RESEARCH

# Product News



## Busway System (1)

UNI-BUS is a new busway system incorporating a number of novel features. Designed for feeder and plug-in service, the new busway systems are available in ratings from 225 to 775 amps, 600-volt, 2-, 3- and 4-pole with copper or aluminum bus. A single size ventilated steel enclosure accommodates all current carrying capacities. Construction details are identical for both feeder and plug-in types. A unique Duo-circuit arrangement offers low reactance characteristics for both types of bus. Novel flexible fittings serve as elbows, offsets and expansion fittings.

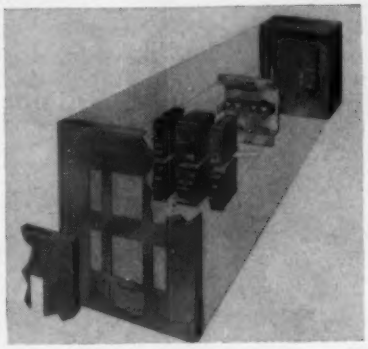
New safety features have been incorporated in the bus and plug designs. A safety slide covers each plug opening. Two heavy studs on the plug activate an interlock which prevents the installation or removal of the plug unless the slide is in the closed position. Opening the slide locks the plug in place. The switch mechanism employs silvered copper stabs which engage the bus surface under high pressure. On closing, the stabs are thrust against the bus, then the switching or circuit breaker contacts close. On opening, the switching contacts open, then the stabs withdraw into the plug body. Load current cannot be interrupted on the bus bar. In the open position all parts of the plug are "dead" and the safety slide may be closed.

*Roller-Smith Corporation, Bethlehem, Pa.*

## Load Centers (2)

New circuit breaker load centers designed for use as service entrance equipment in homes of all sizes, apartment houses, and light commercial applications such as garages, shops, and small office buildings. Available with 8, 12, 16 or 20 circuits, the load centers are equipped with 100-amp main lugs. They are listed by Underwriters' Laboratories. The 16-circuit load center is a "split-bus" design in which one 2-pole circuit breaker feeds up to eight other breakers on the subdistribution portion of the bus. This allows the load center to be used without a main disconnect switch for service entrance equipment in compliance with NEC requirements.

Fronts with doors are available for the 12-, 16-, and 20-circuit load centers. The new interior mounting clips perform two functions. They not only hold the interior and circuit breakers tightly in place, but their "buggy-spring" action provides automatic 2-way alignment when the load centers are installed. Circuit breakers align with the front and the front aligns with the wall surface for flush mounting. To obtain extra hand room for drawing conduit and lead wires into box, the electrician unsnaps the interior and removes it completely, then snaps it back into place for connecting breaker leads.

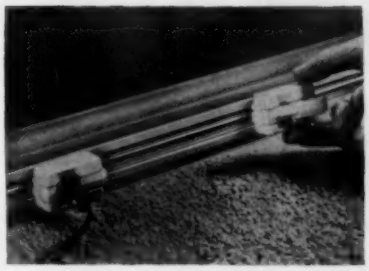


All current-carrying parts are silver-plated copper. Boxes are finished with a Bonderite coating which seals the paint to metal and protects against rust. Dead-front construction isolates live conductors for the users. Load centers use Type R single-pole and Type TQL double-pole common trip circuit breakers. Both types of breakers provide thermal and independent magnetic tripping action for protection against short circuits and prolonged overloads. Both general purpose and raintight enclosures are available for the load centers, and fronts for either surface or flush mounting can be specified. Catalog is available.

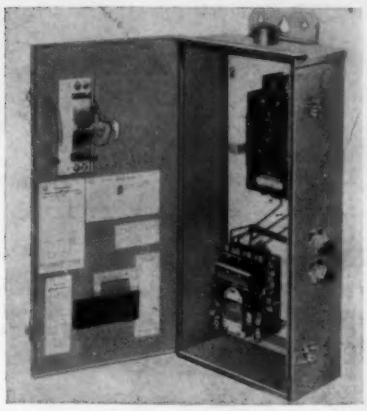
*General Electric Company, Trumbull Components Department, Plainville, Conn.*

## Outlet Strip (3)

Electrostrip is designed to do away with the inconvenience and annoyance of badly located or inadequate wall plugs. Although rigid, this vinyl plastic strip can be hand molded to go around corners and posts. It can be attached along the baseboard or any place on the walls. Specially designed and fused receptacle plugs can then be attached to any point along the strip. Raising a tiny lever releases the plug for re-use at another location. The strip can be wired to existing outlets, or can be initially installed in new construction. It is listed by Underwriters' Laboratory. It is available in 250-ft. rolls and is ivory in color.



*BullDog Electric Products Company, 7610 Jos Campau, Detroit 11, Mich.*



## Control Panel (4)

A new rain-tight control panel for outdoor service is designed for reliable motor control under a wide variety of climatic conditions. Combining a Life-Linestarter with either an AB circuit breaker or a fused De-ion visible-blade switch within a rain-tight cabinet, the panel is capable of accurate overload and short circuit protection. Cabinet is made of Bonderized sheet steel for protection against rust or corrosion. A continuous neoprene sponge gasket ensures a rain-tight seal when cover is closed and its luggage type latches are fastened. Mounting brackets at top and bottom are suitable for pole or wall mounting. Control panel is available for 220- or 440-volt application, in NEMA sizes 1 through 4, and in ratings up to 100 hp. Low voltage protection is standard and two overload relays are installed as standard equipment.

*Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.*

45° ANGLE  CONNECTOR

# NEW midwest ANGLE CONNECTORS

**APPLICATION**

45° and 90° angle connectors for non-metallic cable, armored cable, flexible steel conduit. Connectors are two-screw, hinged cap; are designed for neat and quicker installations for O.E.M. as well as regular trade applications.

**★ ENGINEERING**

These fittings are designed with a screw on each side of the opening to provide a secure grip on the cable. Screws are of sufficient length to permit cable to be installed without removing cap.

**MATERIAL**

Connectors are made with a malleable iron body, formed steel cap and locknut; thoroughly cadmium plated for protection against corrosion.

**SIZE**

Connectors are standard trade size 3/8", for 1/2" threaded hub or knockout. Minimum and maximum openings for cable are 3/8" and 21/32".

90° ANGLE CONNECTOR

Here is another Midwest development in providing quality fittings. "Quality" is just a condensed way of saying: "Getting the total job done—right—with the most inexpensive combination of material and man hours." Engineering and producing quality fittings to meet the highest standards of electrical wiring installations, is our objective at Midwest.

**Midwest Electric Mfg. Company**

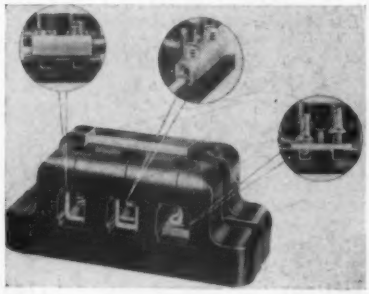
MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

1639 W. WALNUT STREET
Chicago 12, Illinois

## Safety Switches (5)

A new and improved line of Type D (NEMA Type G) safety switches in 30-, 60-, 100-, 200-, 400- and 600-amp capacities. The 30-amp line of Type D switches has been redesigned to embody the same desirable plus features that make all Federal Noark switches easy to install and maintain. In addition, styling of enclosures is modern and uniform throughout the line. Type D switches feature solderless lugs and feed-through neutral for quick installation. Ample gutter space is provided for ease in wiring. Visible knife blades insure safety, and all live parts are completely recessed to eliminate danger of accidental contact. Dual blade construction and fewer joints assure cool operation and trouble-free service. All moving parts and contacts are visible for inspection and maintenance. Type D switches are available in uniformly styled raintight enclosures with mounting ears that facilitate installation on posts and irregular surfaces. They are approved by Underwriters' Laboratories, Inc., and are suitable for use as service equipment.

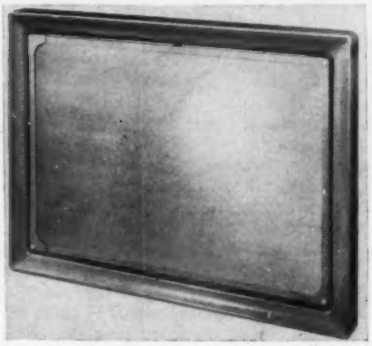
*Federal Pacific Electric Co., 60 Paris St., Newark, N. J.*



## Terminal Block (6)

New Pres-sure-block design allows any number of circuit sections to be assembled into a 70-amp, 750-volt sectional terminal block. One-piece ruggedness of assembled circuit sections is achieved through Pressure-pin design of three integrally molded serrated pins which locate and secure each circuit section by mating with corresponding holes in the adjoining circuit section. Pres-sure-pin design permits limitless circuit sections to be assembled without inherent disadvantages of conventional sectional blocks having accessory fastening hardware or loose fitting sections. Each circuit section is covered and is complete with a factory installed contact. Three contact types are available for stripped or terminal ended wire with a range of No. 18 through No. 4 wires. Pres-fit sections are available either factory assembled or in sections for user's assembly with pneumatically or manually operated assembly fixture. Slip-fit sections are available for user's hand assembly and disassembly.

*Buchanan Electrical Products Corporation, Hillside, N. J.*



## Radiant Electric Panel (7)

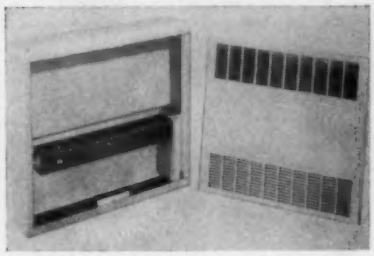
A new type radiant electric panel, known as Crystalite panels. A newly patented Crystalite heating element is fused in a special perma-tempered glass. It assures an instantaneous, even flow of heat to all parts of the plate through an element permanently fused with the glass. A special coating on the back of the plate provides additional reflectivity and prevents electrical leakage from the element. The Crystalite element offers a practical heating method for motels, hotels, churches, schools, offices, and other commercial establishments as well as homes; and answers a particular heating need of farm families or operators of tourist cabins in rural and mountain areas where electricity is the only, readily available source. The panels are available in both wall and baseboard models which may be either surface-mounted or recessed. A new radiant, electric, portable heater for auxiliary spot heating has also been developed.

*Crystalheat Company, Van Nuys, Calif.*

## Weatherproof Socket (8)

A new all rubber weatherproof socket, approved by Underwriters' Laboratories at a 660-watt, 600-volt rating. Primarily for outdoor use, socket features a rough, all rubber, watertight construction designed for heavy duty work. Made with No. 14 Type R, U. L. approved wire (1 lead white and 1 black), with ends stripped 1-in. for easy connection, it has a nickel plated screw shell and bakelite washers.

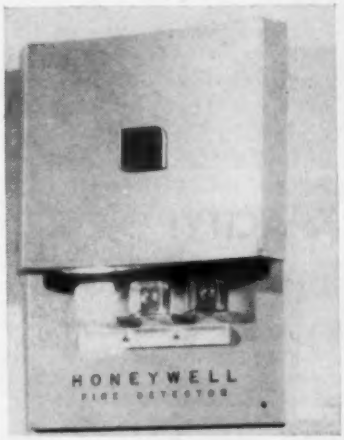
*Eagle Electric Mfg. Co., Inc., 23-10 Bridge Plaza South, Long Island City 1, N. Y.*



## Electric Heaters (9)

A new line of baseboard radiation and cabinet heaters have been designed with two individual heating elements which are regulated by a modulating thermostat. Low capacity heat is provided with one element working, sufficient for 90% of the time. When temperature drops very low outside, the second element comes on. Heat flow is modulated, a feature in demand-rate areas. Units are made in cabinet types for surface or recessed wall mounting and in baseboard radiation types for use along outside walls and windows. Units provide clean, steady heat and are free of moving parts, assuring trouble-free noiseless operation.

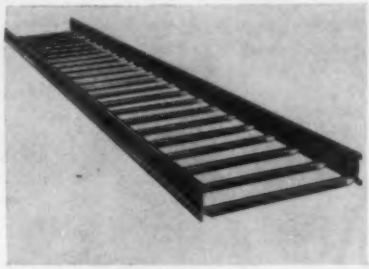
*Electrovector Inc., 1660 E. New York Ave., Brooklyn 12, N. Y.*




## Fire Alarm System (10)

A new home fire alarm system that gives the homeowner early warning of fire and tells him at a glance the approximate location of the blaze. The round-the-clock home fireman consists of a single bronze-finished fire alarm panel and up to 30 fused-link temperature detecting elements strategically placed throughout the house. A fire in any part of the home or garage is detected by one of the temperature-sensitive elements which instantly energizes the alarm signal. At the same time it turns on a light on the master panel showing the homeowner the zone in which the blaze is located. The 5½-in. by 8-in. panel is mounted on a wall in the bedroom, central hallway or other location where it can be seen and heard at all times by someone in the house.

*Minneapolis-Honeywell Regulator Company, 2753 Fourth Ave., S., Minneapolis 8, Minn.*



## Cable Way (11)

A new cable way system provides raceways for cables and tubing. All parts, fittings and straight runs in this trough system are die formed for uniform fit, with modular design of side channels and bottom struts. A universal splice plate joins all parts through side channels without involving the tray bottom. Construction affords flexibility of use in tight places and a variety of combinations of standard fittings. Light weight and increased strength make possible unsupported spans up to 10 feet, reducing required number of supporting members. Bottom struts in the trough are on 6-inch centers, providing ample support for cables and tubes. Steel used is 14 gage, except the covers which are 16 gage. Cable Way is supplied in 6-inch, 12-inch, 18-inch and 24-inch widths, and in 8-foot and 12-foot lengths.

*The Globe Company, 4000 S. Princeton Ave., Chicago 9, Ill.*

## Electric Heaters (12)

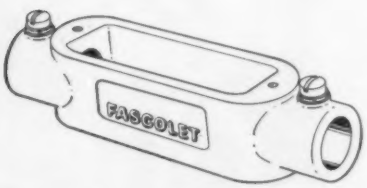
A new series of Chromalox electric baseboard heaters designed for heating entire homes by electricity, for supplemental heating in hard-to-heat rooms, and for auxiliary heating of playrooms, sunporches, etc. It is prefabricated in heavy-gauge steel units of 5-ft., 2-ft., and 1-ft. lengths. With these three lengths, electric heat can be fitted to any wall to an even foot—and blank sections finish out exact wall-to-wall heating. Type BBH baseboard is adaptable to either surface mounting or semi-recessed installation. When semi-recessed against the wall studding, it extends only 1½-in. into the room. Height is 8⅞ inches, depth 2⅞ inches. It produces 540 Btu's per linear foot. It carries Underwriters' Laboratories approval. A four way terminal box allows connections from rear, front, bottom, or either side for quick installation. Separate thermostatic controls are recommended for each room. Thermostatic 2-stage controls are available for closer modulation of heat output to keep electrical demand at a minimum and to match heat output to heat losses of large glass wall areas. Heaters may be painted.

*Edwin L. Wiegand Company, 7500 Thomas Blvd., Pittsburgh 8, Pa.*

## Motor (13)

A newly designed totally-enclosed motor has been designed more compactly than previous types and the same horsepower is provided in less space. Designated as Type J, it is engineered for operation where fumes, dusts and moisture are prevalent. Externally exposed surfaces are of cast iron for corrosion resistance. Frame is a solid cast structure, heavily ribbed around the entire unit for added strength and rapid heat dissipation. Stator core is pre-wound and windings are asbestos protected. Rotor is electronically balanced. Ventilating fan is housed within a protective cast-iron fan guard and has a split hub to facilitate assembly. A new type split-dome conduit box is of heavy cast iron. Type J is available in ratings from 1 to 10 hp and may also be had in fanless type for lower ratings from 1 to 1½ hp. Bulletin No. 1879 is available.

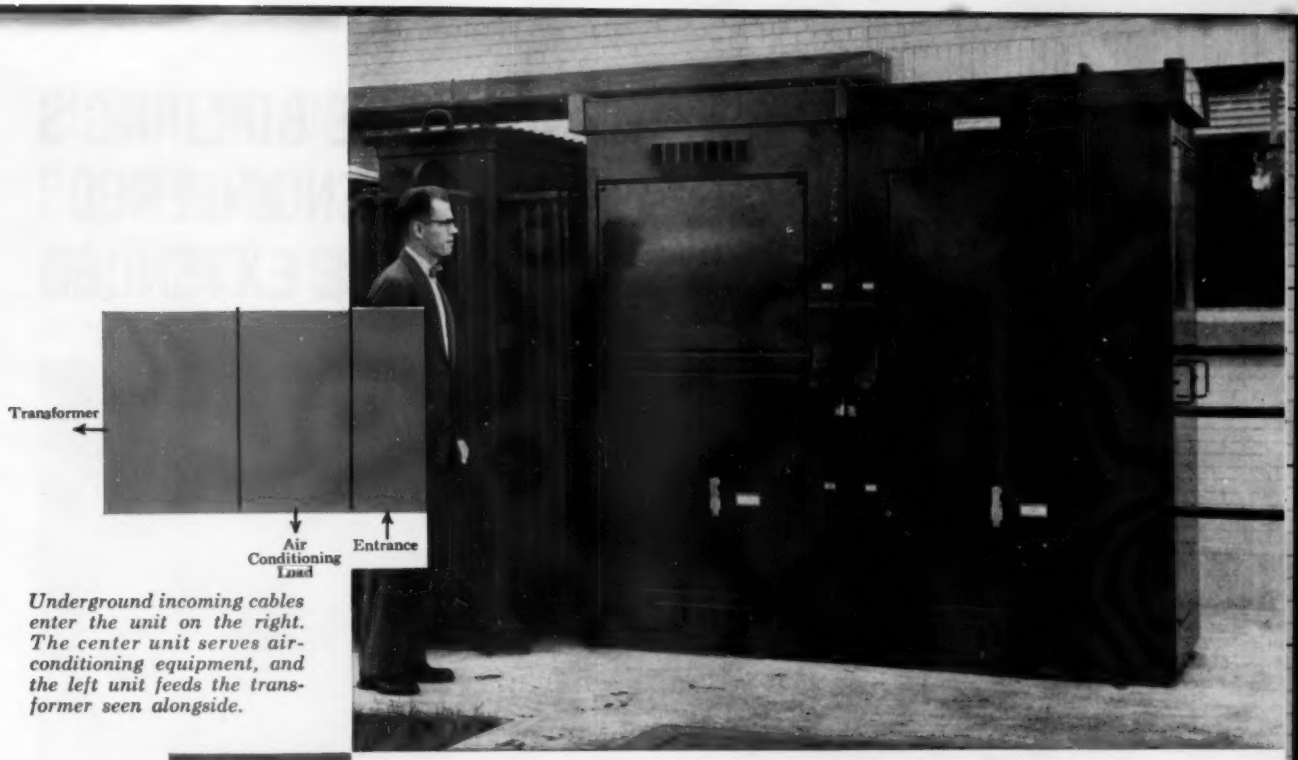
*U. S. Electrical Motors Inc., Box 2058, Los Angeles 54, Calif.*




## Fittings (14)

A new line of set-screw Fascolet fittings for EMT (Thin Wall). They are made of die-cast, rust-proof, non-corrosive aluminum in sizes to take ½-in., ¾-in., and 1-in. EMT, and are available in five different types. All standard covers will fit the Fascolet line. A new feature of these UL-approved fittings is the addition of jumbo-sized, cadmium-plated, cup-point set-screws, together with husky lock-washers. They have a built-in pipe-stop.

*Fast-Lok Manufacturing Co., Ash St. at Bedford, Bridgeport 5, Conn.*




*Underground incoming cables enter the unit on the right. The center unit serves air-conditioning equipment, and the left unit feeds the transformer seen alongside.*

MR. GLENN SHUTTS of White City Electric Co., Chicago, has recommended many installations of S&C Metalclad Switchgear, including the one at G. D. Searle & Co. He says, "S&C gear does the job at a considerable saving over other types. From a service angle it has been perfect . . . we have never had to go back . . . there has been no maintenance . . . no trouble whatsoever. All of our customers are absolutely satisfied. As a result S&C has received many repeat orders."

# You can cut the cost of your high voltage supply system

**Save up to 50% with S&C Metalclad Switchgear**

The installation pictured above—at G. D. Searle & Co., Skokie, Illinois—is another instance of S&C Metalclad Switchgear engineered to reduce the capital outlay for the construction of the electrical supply system.

At low cost—considerably lower than other types of switchgear—S&C equipment provides means for switching and protecting the high-voltage circuits. Its dependability is attested by the scores of successful installations now in service.

S&C field engineers will gladly work with you in reducing your high-voltage equipment costs . . . just pick up the telephone.

*Specialists in High-Voltage Switchgear for Electric Utilities since 1910*

## S&C ELECTRIC COMPANY

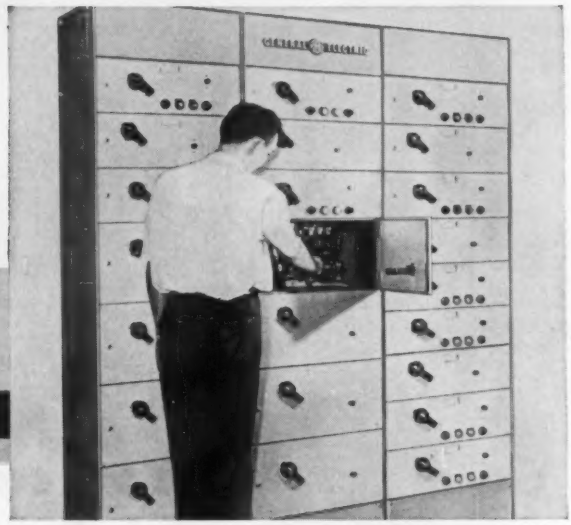
4433 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U.S.A.

IN CANADA:
S & C ELECTRIC CANADA, LTD.
8 VANSCO ROAD, TORONTO 14, ONTARIO

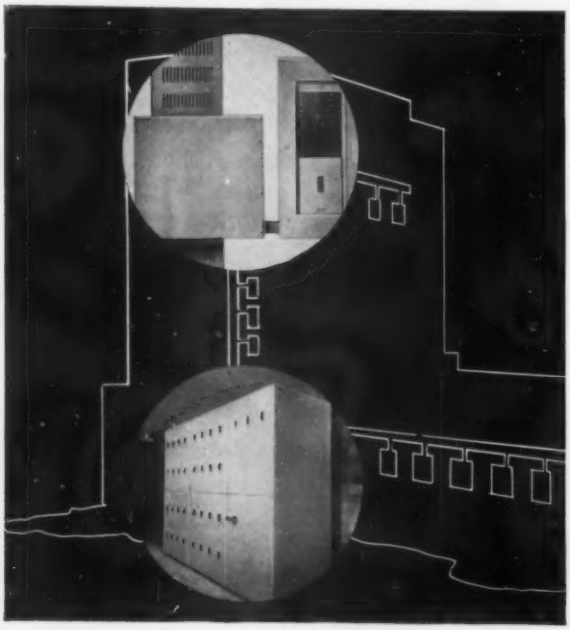
Consult your telephone directory. Sales offices located in Birmingham, Boston, Buffalo, Chicago, Clayton (St. Louis), Cleveland, Dallas, Dearborn (Detroit), Denver, Houston, Huntington, Indianapolis, Jersey City, Kansas City, Little Rock, Memphis, Minneapolis, New Orleans, Philadelphia, Pittsburgh, Portland (Ore.), St. Petersburg, Salt Lake City, San Francisco, San Gabriel (Los Angeles), Seattle, Syracuse, Washington, D. C.

# HOW THE AVERAGE BUILDING'S USING G.E.'s "SYSTEM ENGINEERED" CAN BE EXTENDED

Artist's concept of the fabulous new Coliseum now under construction at Columbus Circle, New York City. More than *2 miles* of General Electric's low-voltage-drop Type LVD busways will go into this unique building—one of the first and by far largest higher voltage 480Y/277 (460Y/265)-volt electrical distribution systems ever installed. The variety and flexibility of G-E equipment enable General Electric engineers to give important assistance to consulting engineers, architects and contractors in their planning of a complete system.



**Built-in Future** of G-E Systems is your answer to forecasts that power consumption in average building will be up 100% by 1965. Here's why: (1) G.E. achieves *true* extendability by designing components to be compact and accessible for addition or relocation. (2) They can be moved and reinstalled with practically 100% re-use of materials. (New Type DA7093 control center above, for example, needs 50% less floor space; has capacity to interrupt 50,000 amperes.) G-E "System Engineered" equipment means 1955 plans can fill future needs.



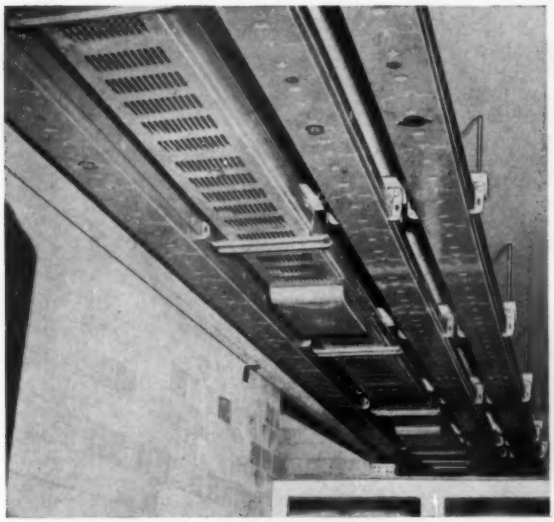
NEW YORK COLISEUM
CONSTRUCTED BY TRIBOROUGH BRIDGE AND TUNNEL AUTHORITY
HON. ROBERT MOSES, CHAIRMAN
ARCHITECTS—LEON AND LIONEL LEVY
MECHANICAL AND ELECTRICAL ENGINEER—GUY B. PANERO
ADVISORY ARCHITECTURAL COMMITTEE—AYMER EMBURY II, EGGERS & HIGGINS, JOHN B. PETERKIN
GENERAL CONTRACTORS—WALSH-FULLER-SLATTERY (JOINT VENTURE)
ELECTRICAL CONTRACTORS—T. FREDERICK JACKSON AND J. LIVINGSTON CO. (JOINT VENTURE)

Cutaway diagram shows tap-offs on risers at each floor of building. Their planned-in-advance accessibility assures flexibility to meet increasing future needs.

• • •

General Electric "System Engineered" equipment provides maximum safety, ease of relocating equipment, reserve power capacity for your future needs. For further details please contact your nearest General Electric Apparatus Sales or Assemblies and Components Sales representative. Or write—GENERAL ELECTRIC COMPANY, DISTRIBUTION ASSEMBLIES DEPARTMENT, PLAINVILLE, CONN.

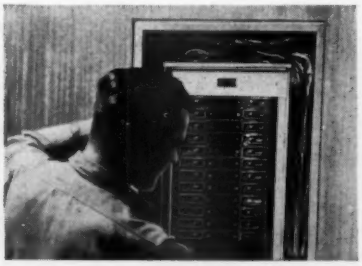
# ELECTRIC DISTRIBUTION, EQUIPMENT, TO MEET 1965's DOUBLED NEEDS!



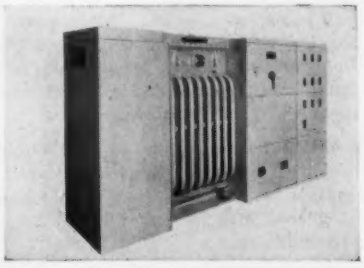
**G-E "System Engineered" Equipment** is reverse of hodge-podge products using non-integrated parts. (3) Standardized parts throughout G-E System make faster, less costly extension or alteration possible. (4) Since components—control centers, busways, switchboards, panelboards, sectional distribution centers—are engineered to work together, your G-E System *must* give most efficient service and reduced maintenance costs. (G-E Flex-a-Power* busways, above, allow *complete* relocation of loads without rewiring.)

**One source of supply** is another important cost-reducing factor in G-E "System Engineered" Equipment. (5) Naturally, it simplifies your job because you deal with only one man, the skilled General Electric engineer. He works with consulting engineers, architects and owners from the planning stage to completion of building. He helps them save many hours and dollars. (6) Most important, your G-E man is not selling just products. He is providing G-E "System Engineered" equipment that is designed with a long *built-in* future.

**Switchboards** — For reliable control, distribution and circuit protection. Completely wired at the factory. Large air or molded-case circuit breakers, fusible switch units, meters, instruments and accessories already installed.



**Panelboards**—Types NAB, NHB, NLAB, NLTQ, NLTQX, NTP, NTC for lighting—types NCB, CCB, Swing-WA* and Converti-Fuse* for power distribution. Complete line. Factory-assembled for fast, compact installation.

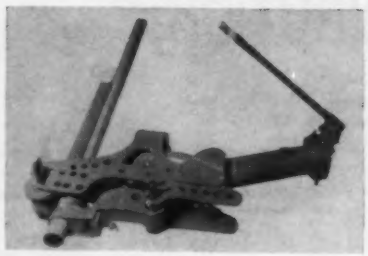


**Sectional Distribution Centers** —Factory-assembled to reduce installation cost. Short secondary feeders in load-center system mean less voltage drop—rarely more than 2 to 3%. Easy-to-order arrangements eliminate tedious detailing.

*REGISTERED TRADE-MARK OF GENERAL ELECTRIC COMPANY

*Progress Is Our Most Important Product*

GENERAL ELECTRIC



## Bending Tool (15)

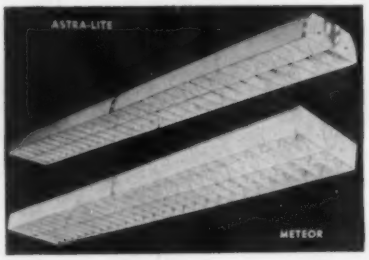
A portable hydraulic bending tool for bending both pipe as well as tubing. The hydraulic One Shot pipe benders are equipped with a newly developed frame, making it possible to bend pipe, rigid conduit, as well as thinwall conduit (EMT), hard and soft copper, aluminum and steel and any other tubing in 90° and 180°. Existing equipment can be converted.

*Tal Bender, Inc., Milwaukee 2, Wis.*

## Switches (16)

Two new Quiette switches feature Wire-lock screwless terminals and built-in shunts. The shunts permit continuous wiring from one switch to another in multiple gang installations. Q-21 has a grounding line internal shunt with the toggle controlling the hot line, while the hot line of Q-22 supplies current to two screwless terminals, one of which can be switched on or off. Both are single pole switches and are rated at 15 amps, 120 volts, ac only.

*Arrow-Hart & Hegeman Electric Co., Hartford, Conn.*




## Fluorescent Fixtures (17)

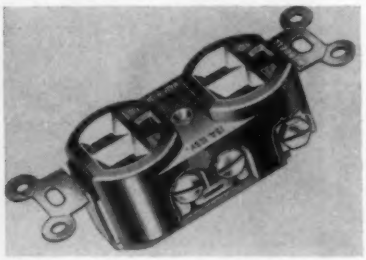
Two new series of shallow Fleur-O-Lier luminaires known as "Meteor" and "Astra-Lite." The Meteor series is for use in schools, offices and stores. The Astra-Lite is designed for commercial, institutional and industrial installations. Shallow body measures 4½ inches overall, including louvre assembly and ballast. Both units are available in general diffuse, direct and semi-direct types, slimline and rapid start, 2-and 4-lamp, in 4-, 6-, and 8-ft lengths. Side shielding is of metal or plastic. Louvres are standard equipment. Astra-Lite is also designed for installation as an open bottom luminaire without louvres. Both units are complete for either individual or continuous row installation. Literature is available.

*Metalcraft Products Co., Inc., Mascher & Lippincott Sts., Philadelphia 33, Pa.*

## Flood Lamp (18)

A new 200-watt PAR-46 flood lamp of the all-glass sealed-beam type for indoor and outdoor lighting. It is equipped with a side-prong base and designed to produce a controlled beam of light substantially rectangular in pattern. Its glass is thermal shock-proof. It produces a "narrow to medium" distribution of light from a compact source. Other advantages are: a smooth beam; flexibility of aiming; and good maintenance of light with a minimum need for cleaning. It has a maximum all-over length of four inches, a life rating of 2,000 hours, and is designed for use in any burning position.

*General Electric Co., Nela Park, Cleveland 12, Ohio*



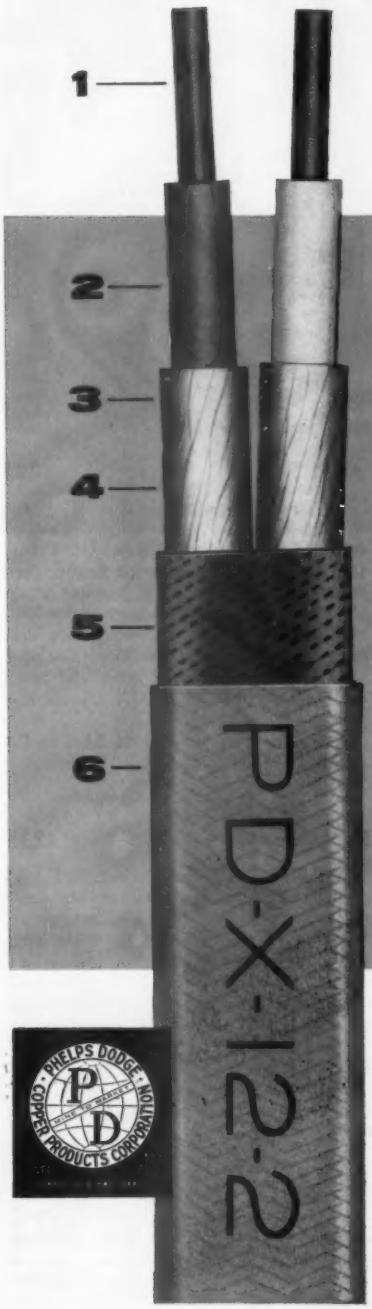
## Convenience Outlet (19)

A new 3-wire grounding-type convenience outlet designed for grounding exposed metal parts of portable electrical equipment. The unit, known as Catalog No. 5252, is a duplex, flush mounted receptacle for all practical applications. Features include large head binding screws for conventional wiring, plus a hexagonal green screw to denote grounding wire. A break-off feature is provided for 2-circuit installations. It may be used with both metallic or non-metallic wiring systems. Available in brown bakelite and ivorine.

*Harvey Hubbell, Inc., Bridgeport, Conn.*

*Contractors agree...*

# You can't beat Phelps Dodge Dependable PD-X Cable for fast, easy stripping!




*Habirshaw type NM nonmetallic-sheathed cable saves vital on-the-job time and money!*

Phelps Dodge Copper Products Corporation's new PD-X cable is the fastest-stripping, cleanest-working nonmetallic-sheathed cable on the market today. Here's why:

1. Copper conductors are *soft* drawn. Connections are easily and quickly made.
2. Habirdure Thermoplastic Insulation is clean and smooth —makes stripping *simple, easy,* fast.
3. Paper armor is resin-treated to resist moisture, is clean and dry—no oil, grease or wax is used.
4. Paper armor is applied with a long twist and can be removed by an easy flick of the fingers. No time-wasting unwinding, no sticking to underlying insulation.
5. Barrier tape keeps finishing compounds out of the cable —leaves inside clean and free of gum. *Strips off cleanly as a unit with outer braid covering.*
6. New clean, grey finish eliminates sticking, *assures easy pulling,* clean walls and hands.

**See Your Phelps Dodge Distributor!**

## PHELPS DODGE COPPER PRODUCTS CORPORATION

**SALES OFFICES:** Atlanta, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Roanoke, San Francisco, St. Louis, Seattle, Washington, D. C.

## Motor Starter (20)

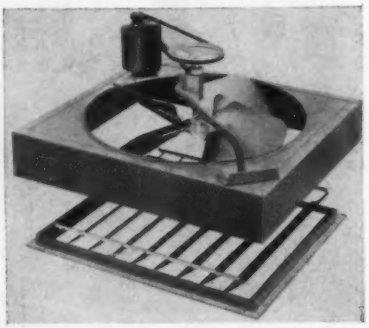
A new manual motor starter which provides across-the-line starting as well as overload protection for fhp motors driving small machine tools, woodworking equipment, fans, blowers and similar machines. Operation of starter is by an "on" and "off" standard type toggle lever. Snap action, twin break silver contacts reduce arcing and provide increased contact life. Starter has straight through wiring with line terminals at top and load terminals at bottom, all permanently identified by terminal markings moulded into the base. Eutectic alloy thermal overload relay with inverse time limit features is incorporated in new starter and is offered in both double and single poles; both open and enclosed types. The enclosed type has a wrap around cover with a self-retained fastening screw, the interior being accessible from the front and both sides for wiring. Knockouts for ½-in. conduits are included in both top and bottom. Starter has "break-off" plaster ears and will fit a standard surface or flush type outlet box. Publication EC-61 is available.

*Cutler-Hammer, Inc., 228 N. 12th St., Milwaukee, Wis.*

## Panelboards (21)

A new line of quick-make and quick-break plug-in fusible distribution panelboards, known as QMB Saflex. Standardized plug-in components can be stocked by local distributors. Plug-in components include both main and branch circuits as large as 200-amp, either 250 or 600 volts. Interiors, fronts, and three box sizes are simple to stock. The 30-, 60-, 100- and 200-amp units, 2- and 3-pole, 250 or 600 volts are equipped with plug-in tabs and are easily plugged onto round bus bars. The larger 400- and 600-amp units are bolted to flat bus bars and are available in factory assembled panels. The units and solid neutral may be added, interchanged or removed easily, providing a flexible panel. All units are dual hp rated for standard and time delay fuses. Branch units are individually enclosed and have front operating handles of cast aluminum. Factory assembled panelboards are available with 200- through 1200-amp mains and may be obtained with or without cabinet door. Bulletin is available.

*Square D Company, 6060 Rivard St., Detroit 11, Mich.*



## Attic Fan (22)

A new 32-in. attic fan, called the "Suburban", complete with shutter, can be installed in a 36-in. hallway. Other features include: G. E. all-angle motor; permanently lubricated ball bearing blade shaft; counter-balanced blades and pulley, all-steel, electro-welded construction, and an automatic aluminum shutter. The new RSV Suburban model is quiet, and powerful, and bears the PFMA seal of approval.

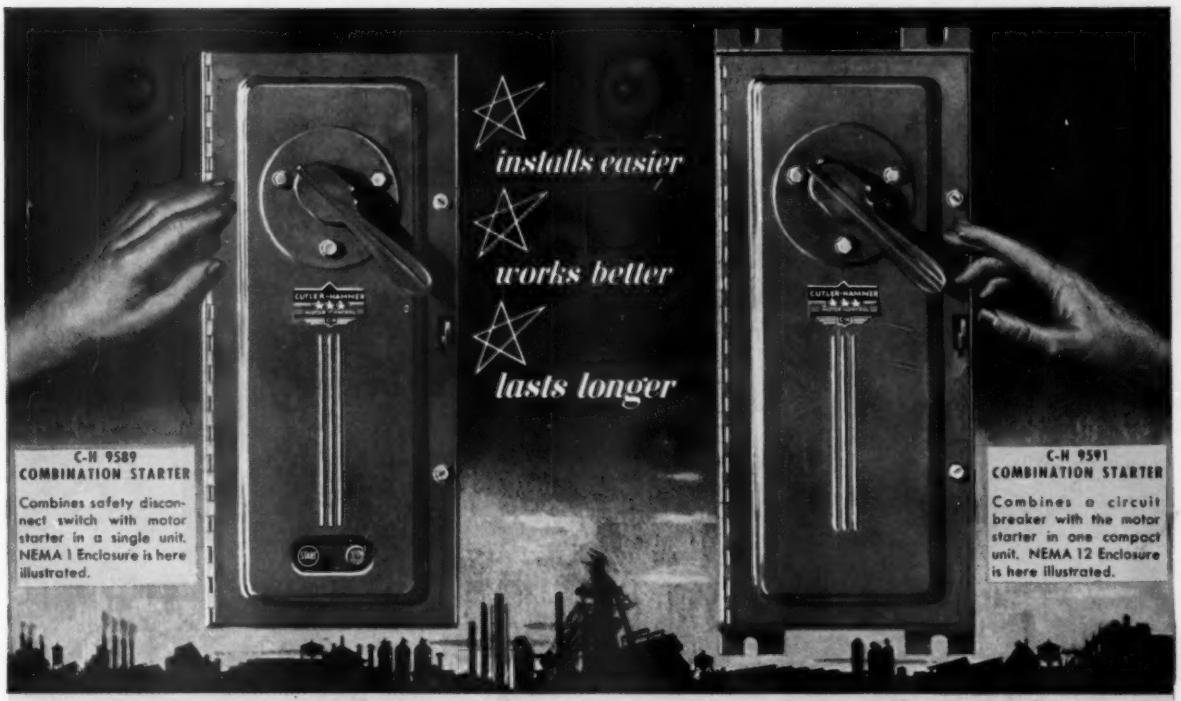
*Reed Unit-Fans, Inc., 1001 St. Charles Ave., New Orleans, La.*

## Pliers (23)

The new Sta-kon Plus pliers, WT-161, perform all the functions of an electrician's pliers and installs a wide range of Sta-kon terminals, splicers, and wire joints. Features of the tool include an electrician's side cutter and a clover-leaf installing nest and indentor. This design allows the tool to install A, B and C series Sta-kon terminals (No. 22 to No. 10 wire) and wire joints, (PT60 and PT70,) to meet all Underwriters' Laboratories requirements. Forged from carbon-vanadium steel, the new tool is tempered to four controlled zones of hardness for convenience in cutting copper wire. The tool has special, built in surfaces which facilitate insulation crushing. Specially shaped handles are covered with plastic cushion grips.

*The Thomas & Betts Co., 36 Butler St., Elizabeth, N. J.*

# New Combination Starters in the Spectacular Line of Cutler-Hammer ★★★ Motor Control



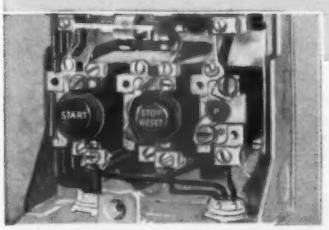

Users have had many dramatic proofs of the advantages built into Cutler-Hammer ★ ★ ★ Motor Control. They *know* the three silver stars on the Cutler-Hammer nameplate identify control equipment that sets three entirely new standards of motor control performance and value.

Star #1: Amazing savings in installation costs which often exceed the cost of the control. Star #2: Performance so uniform and dependable that *this* control often saves many times its cost by the production interruptions it avoids. Star #3: Life so greatly increased that this control *never* requires maintenance expense in 90% of its uses.

Now combination starters are available in this spectacular new line of Cutler-Hammer ★ ★ ★ Motor Control. Your nearby Cutler-Hammer Authorized Distributor has been stocked and is ready to serve you. Bulletin 9589 Starters incorporate a rugged disconnect switch of advanced design with or without fuses. Bulletin 9591 Starters are equipped with circuit breakers. Order *now* for prompt delivery.

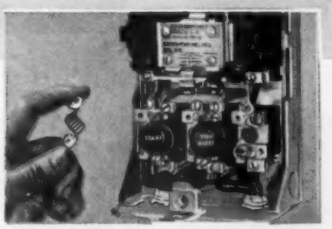
CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

CUTLER-HAMMER
★ ★ ★
MOTOR CONTROL
C-H



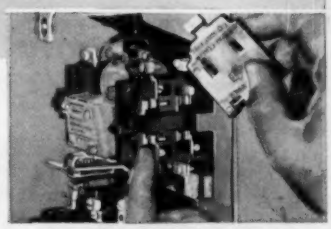
**Full Three-Phase Protection**

Only *three* overload relays can give complete three-phase protection to avoid motor burn-outs and their costly interruptions to production. And *only* Cutler-Hammer offers this complete three-phase protection in standard combination starters. You pay only for the third relay, nothing extra for special engineering or special enclosures.



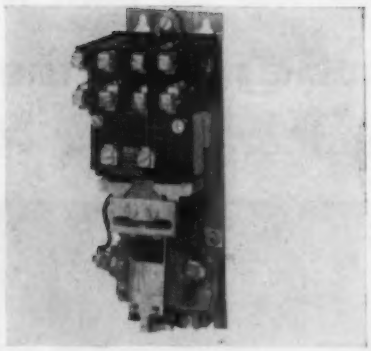
**Adjustable Load Sensing Coils**

The accurate adjustment of overload protection permits motors to work harder without damage to motor windings. This is more important than ever with the newer type small frame motors. Adjustable load sensing coils in these new starters provide 3% loading accuracy instead of the 10% to 12% accuracy in competitive control.



**Superlife Vertical Contacts**

Experienced control users insist on dust-safe vertical contacts. And now the famous Cutler-Hammer vertical contacts have been doubly improved. First, their new lightweight design cuts bounce to reduce arcing. Second, any arcing that might occur is now pressure-quenched. Compare performance and see the difference.



## Relays and Contactors (24)

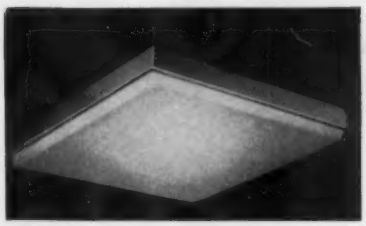
New mechanically-held contactors and relays, especially designed for maintaining continuity of sequencing in the event of power interruptions. Used also where exceptionally quiet operation is required, mechanically-latched relays and contactors eliminate continued energization of the coil, thus eliminating coil hum. With contacts interchangeable from normally open to normally closed position without additional parts, the devices are entirely front-connected for convenient wiring. Mechanically held contactors are available in NEMA sizes 00, 0, 1, open and enclosed, and in 1, 2, 3 and 4 poles. Mechanically-held multipole relays are available in 10-amp, 600-volt max ratings, open and enclosed, and with 2, 3, 4, 6 and 8 poles, in any combination of normally open and/or normally closed positions. Bulletin GEC-1281 is available.

*General Electric Co., Schenectady 5 N. Y.*

## Fixture Lowering System (25)

A new method of lowering lighting fixtures. Called Cablematic Lighting, the system employs a steel cable which loops through a fixture disconnect mechanism at each lighting outlet. Both ends of the cable are anchored and enough slack is provided to lower only one fixture. When a lighting unit is lowered, electrical contact is broken at the outlet and the counter-balanced cable loop suspends the fixture at any comfortable working height. As the second fixture in a row is lowered, the first fixture automatically rises into place and in service. A single counterweight and cable accommodates any number of fixtures in a row. When the weight is at its "low" position, all lighting units are in operation. Since the cable lays alongside the lighting raceway, there is no cobwebbing of ceiling and no need for special cable hanger fittings and brackets.

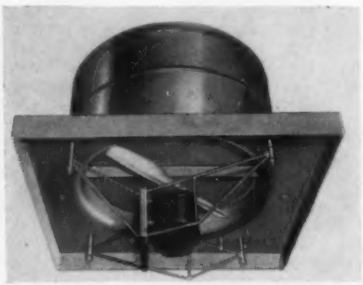
*Wil-Son Manufacturing Company, 700 Huston Street, Cloverport, Ky.*



## Diffusing Luminaires (26)

Multi-Plex is a complete series of fully-enclosed modular low-brightness diffusing units. They feature Plexiglas diffusing drop-panels, uniform diffusion and efficient distribution. Available for surface or recessed mounting in 12-, 24- and 48-in. modular widths, and in all standard lengths. An unlimited range of designs for any existing or new ceiling is possible by combining units into rows, patterns, areas or squares; or by mounting them individually. Made of heavy gauge steel, all-welded, finished in high-reflectance baked white enamel, units are easily installed without need for structural changes in ceilings. All models are available with 45° by 45° plastic louvers instead of diffusing panels. Catalog is available.

*Leadlight Fixture Co., 10222 Pearmain St., Oakland, Calif.*

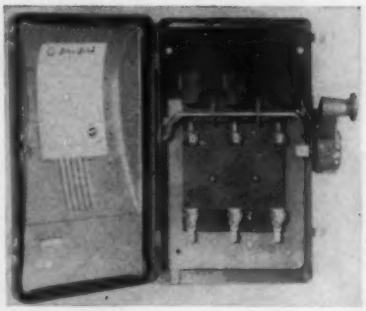


## Roof Ventilator (27)

The new "Vertiflow" roof ventilator consists of a galvanized steel windband mounted over a curb base of galvanized steel. Fan mount is bolted directly to base, with inner diameter in base formed into a fan ring. Galvanized lids in windband turn on plastic bearings—opening when fan is on, closing weather-tight when it goes off. When lids are open, air stream prevents entrance of rain or snow. Unit is available in 18-, 24-, 32-, 36- and 42-in. models, with capacities from 3000 to 26,400 CFM.

*Hartzell Propeller Fan Company, Piqua, Ohio*

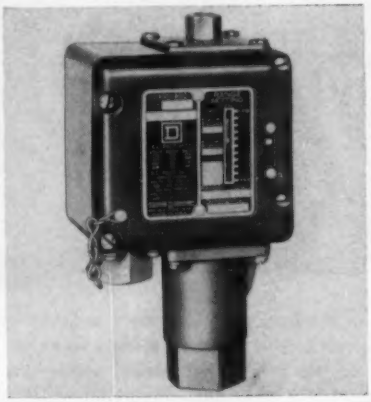

BALDOR
BALTRIC...
THE MOTOR THAT COULDN'T
BE BUILT BEFORE
Now, in a complete line of totally enclosed motors, Baltric brings you the best answer yet to your motor problems. Less weight . . . less bulk . . . better performance, are the results of advanced engineering and new and better materials.
The new Baltric Motors pack much more power per ounce . . . permit applications and installations of greater versatility. Simple in design, rugged, yet compact and dependable, Baltric does a better job in less space than old-style motors. Baltric is a better bet for every use.
Baltric Motors are available in a complete range of models, ⅙ h. p., through 5 h. p., squirrel cage induction type, both polyphase and single phase. Baltric Motors can also be engineered to meet your special mechanical and electrical requirements.
Original Streamcooled Baldor Motors Available—Built to Former NEMA Standards
ALL BALTRIC MOTORS TOTALLY ENCLOSED AND STREAMCOOLED
BESS-3
BALDOR ELECTRIC COMPANY
Baltric Motors Are Available in Polyphase
Squirrel Cage • Induction and Single Phase
Capacitor Start • Induction Run Types
4353 DUNCAN AVENUE • ST. LOUIS 10, MISSOURI



## Safety-Switch (28)

A Type H safety switch for heavy duty industrial use. It features a dust-resisting enclosure and, for safety during maintenance, Micarta laminated plastic shields over the line terminals. It is available in ratings from 30 to 1200 amps, 600 volts and below. Incorporation of operating mechanism within the operating handle leaves the side gutters free from wiring. Copper parts are tinplated to prevent corrosion and oxidation and switch bases are coated with iron oxide cement to increase moisture resistance and dielectric strength.

*Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.*



## Pressure Switch (29)

A newly designed, piston-operated hydraulic pressure switch for use on hydraulic machine tool applications where surges of considerable magnitude are present. A new strain relief mechanism has been incorporated in the switch which allows the range spring to absorb the impact of a violent pressure surge. There is a Quad ring seal around the piston, preventing oil leakage and eliminating the necessity for an oil return line. Types without the Quad ring are available for closer differentials. Switch has snap action contacts—one normally open and one normally closed in a self contained, arc-resistant melamine case rated for ac or dc control circuits. Oil-tight and explosion-resisting enclosures are available. Switches may be obtained with a range of 135 to 1000 psi or 400 to 3000 psi. They have closed differentials and are easily adjusted in the field.

*Square D Company, 4041 North Richards Sts., Milwaukee 12, Wis.*

## Replacement Units (30)

A 5 and 15 kv class circuit-breaker arrangement known as a replacement unit. The purpose of this unit is to replace obsolete circuit breakers of insufficient interrupting capacity by modern drawout assemblies. Replacement unit is a packaged assembly consisting of a compact 24-in. wide cubicle, complete with a truck mounted circuit breaker, fully interlocked. Bulletin 726-100 is available.

*Nelson Electric Manufacturing Company, 217 North Detroit, Tulsa, Okla.*

## Air Conditioning System (31)

A new type year-round air conditioning system for multi-room installations in institutions, hotels, motels, office buildings, stores and residences. "Dual Conditioners" use the same piping circuit now used for heating to cool in summer, heat in winter and ventilate in the off-seasons. Each room or area is supplied with individual thermostat and capacity control to select desired temperature. Each unit is its own zone control, and is independent of all others. A choice of 10 different U.L. approved units, to meet varying capacity needs is offered. Cabinets are rust and sound proof, and can be recessed. In conjunction with the existing hot water boiler, a Circle-Air water chiller of the correct capacity is supplied to complete the year-round dual conditioner system. To cool and ventilate only, the conditioner may be connected to a standard refrigerating condenser unit.

*Circle Air Industries, 244 Herkimer St., Brooklyn 16, N. Y.*

## Conduit (32)

Galvanized threads on its hot-dip galvanized conduit has been introduced. Threads stay bright, clean, rust-free. No rusting in storage, no rusting on job, for threads are also hot-dip galvanized. Threads are clean, sharp and true when they reach the point of installation. Smooth lacquer, used on interior as well as exterior, means easiest fishing of wires. Hot-dip galvanized conduit is now available with galvanized threads on sizes ranging from ½-in. through 6-in.

*Pittsburgh Standard Conduit Co., 61 Bridge St., Pittsburgh 23, Pa.*

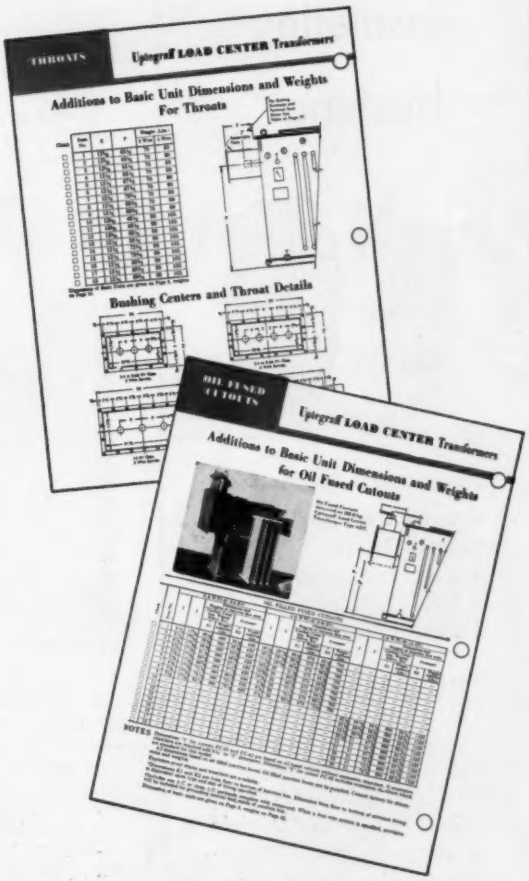

# Uptegraff Announces a complete series of

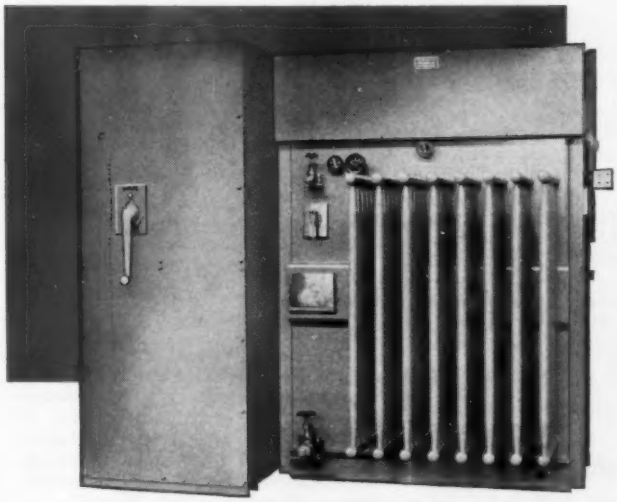
# LOAD CENTER TRANSFORMERS

**(150-2500 KVA)**

Uptegraff announces a new series of *Liquid Filled* Load Center Transformers, made in eighteen ratings, from 150 to 2500 KVA., 3-phase. Designs are based upon extensive experience with this type of transformer, and represent modern engineering and manufacturing practice.

To simplify the selection and arrangement of auxiliary equipment, we have prepared a unique brochure, some pages of which are shown here. With this brochure, you can readily determine overall dimensions, total weights and other information for any combination of the Basic Transformer Unit with various types of switches and accessories. A check system permits the easy and accurate locating of desired data pertaining to various arrangements of properly rated equipment for any selected basic unit. We will be glad to send you a copy, free.



**R. E. Uptegraff Manufacturing Co.**
**Scottdale, Pennsylvania**

**Send** for a free copy of this 20-page data book, giving important and useful information on Uptegraff Load Center Transformers. Fill out and mail the coupon below.

R. E. Uptegraff Manufacturing Company
Scottdale, Pennsylvania

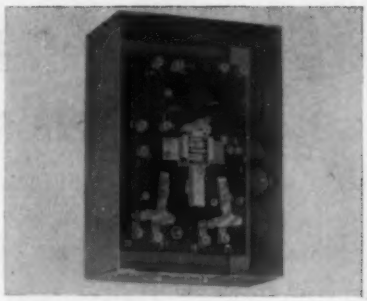
Please send a copy of your LOAD CENTER TRANSFORMER brochure, Catalog 132, to:

Name_____ Position_____

Company_____

Address_____

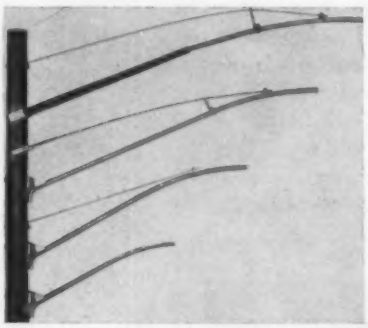
ECM-3



### Time Relay (33)

A new time delay relay permits any delay from ½ to 6 seconds on standard ac voltages (120, 240, 460 and 600 volts, 60 cycles). It is also available for other frequencies and for dc. The relay has a capacity for handling motor loads directly, providing relay and contactor in one unit, in a semi-dust-tight cabinet for protection against dirt in general indoor applications. The unit has found widespread application: in conjunction with a brake motor for dynamic braking of ac motors; for "single-pulse" time delay; and for repeated cycling.

*Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.*



### Luminaire Supports (34)

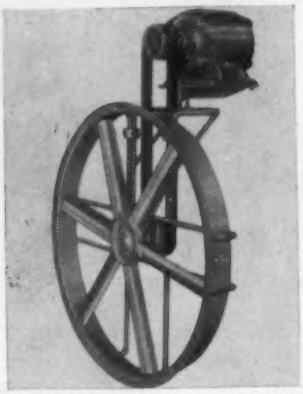
A new line of upsweep luminaire supports are particularly applicable to joint use poles where pole space is at a premimum. The basic style of the line is an upsweep pipe support. The four styles, in varying lengths (2-ft. increments), are: 4-6-ft. without guy rod, 4-10-ft. with guy rod, 8-16-ft with double guy rod, and 10-20-ft "A" frame with single guy rod. All styles are available in 1¼-in. steel or aluminum pipe, while the "A" frame type is also available in 2-in. steel or aluminum pipe.

*Line Material Company, 700 West Michigan St., Milwaukee 1, Wis.*

### Emergency Light (35)

Sentry-Lite, Model 200X, is designed to provide instant automatic emergency light over large areas, if power is interrupted. Automatic recharger operating on standard electrical power keeps battery up to peak capacity at all times. Test panel has momentary switch for test as to function. AC fuse mounted on face panel. Toggle switch to cut off light to conserve power in extended power failure. Pilot indicator light. Unit measures 8- by 13- by 16-in. Sentry-Lite 100-amp battery provides more than 12 hours of continuous operation. Unit is topped by two 5000 candle power sealed beam lamps.

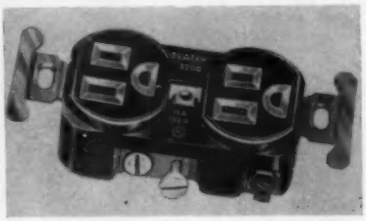
*Hobby & Brown Electronic Corp., 55 Front St., Rockville Centre, N. Y.*



### Exhaust Fan (36)

A new Series "R" belt-driven exhaust fan has been added to this line. It is manufactured in a complete range of sizes 12-in. through 48-in. diameter, with capacities from 900 to 38,000 CFM, suitable for operation against static pressures up to 1½-in. Design features include nonsparking, non-corrosive solid-cast aluminum blade, sealed-for-life ball bearings, adjustable motor mount support, heavy duty construction. Fan is designed to accommodate any standard stock motor of proper rating. Available with or without motor from factory.

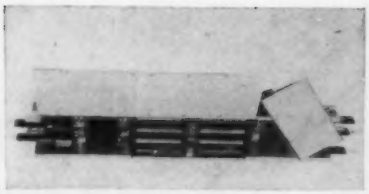
*M & E Manufacturing Co., 2571 Winthrop Ave., Indianapolis 5, Ind.*



### Receptacle (37)

A residential Grade, "U" shaped grounding type duplex receptacle with a rating of 125 volts, 15 amps. It meets NEMA and ASA standards. No. 3200 features "channel-lock", which permits back or loop wiring. It can be used for appliances and power tools that require grounding. Other features are: grounding of metallic system wiring is direct; grounding of non-metallic systems is through a third wire acting as a grounding conductor; slots can accommodate 2-wire regular and polarized caps; plaster ears; hexagonal green screw for grounding type wire.

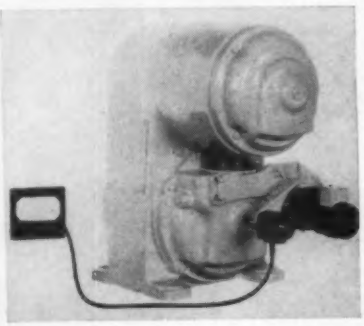
*Slater Electric & Mfg. Co., Inc., 56th St. & 37th Ave., Woodside, N. Y.*



## Fitting for Bus Duct (38)

An adjustable straight length of bus duct can be lengthened or shortened on the job by as much as six inches. The fitting is designed to facilitate the layout and installation of bus duct by decreasing the precision required for good results. Greater tolerances permit flexibility in placement of fixed apparatus and simplify connections to apparatus already in place. Fittings are available in copper or aluminum for all ratings of plug-in duct and for all indoor low-impedance duct having two bars per phase. Fittings are rated up to 1500 amps in copper, 1000 amps in aluminum. In ventilated enclosures, indor low-impedance copper fittings are rated to 3000 amps; when totally enclosed, to 2250 amps. Aluminum fittings are rated to 1600 amps. Both fittings are rated at 600 volts or 2- or 3-wire units. 4-wire units are rated at 277/480 volts and are available with either half or full neutral.

*Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.*



## Motor (39)

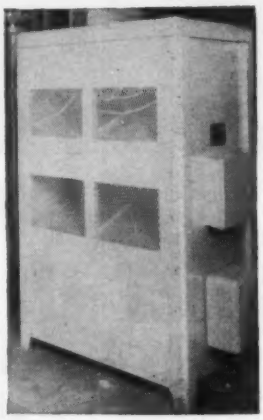
The Speed-Trol variable speed drive can now be equipped with a direct pick-up electric Tachometer. The device includes a signal generator and speed indicator. Standard calibration of indicator is in rpm and it can also be furnished calibrated in various units of product such as feet per minute, gallons per hour, cubic feet per minute. Speed-Trols are available in ratings from 1 to 30 hp in standard, single, double or triple reduction drives.

*Sterling Electric Motors, Inc.*, 5401 *Telegraph Rd., Los Angeles 22, Calif.*

## Fittings (40)

Built-in plastic bushings are used to prevent wiring from coming in contact with the metal of the raceway of the outlet. The bushings are colored bright blue for identification. Called T&B Insuline, the new type fittings are designed for rigid, EMT and flexible raceways. They protect wire insulation from damage. The first Insuline fitting available is for EMT. Others being readied include Tite-Bite connectors for armored cable and flexible conduit, Chase nipples and TB's new insulated metallic bushings. Under development are self-insulated threadless connectors for rigid conduit and liquid-tight raceway connectors. Connectors are listed by Underwriters' Laboratories.

*Thomas & Betts Company, Elizabeth, N. J.*



## Rectifier

A 3-phase, selenium rectifier with no moving parts (convection cooled) stands 5 feet tall and occupies 3½ ft by 5 ft floor space. It is designed to operate on input sources of 200, 440 or 550 volts, ac and to supply 100 amps, 230 volts dc. Other voltage and amp combinations up to 25 kw can be arranged. The unit, housed in a silver grey, hammerloid finish, heavy steel cabinet, is ideal for multi-hp motors and large lifting magnets. Features are over-sized selenium rectifier stacks; built-in thermostatic protection; generous amounts of copper and silicon steel for cool operation; and overload relays mounted on front panel.

*Electronic Rectifier Co., Rochester, N. Y.*

## Flexible Conduit (42)

A new flexible-metal, electrical wiring conduit, which is fully enclosed in a tough, waterproof, synthetic cover. It will be known as Type U20SCB with black synthetic cover with square locked construction, galvanized steel core, aluminum wire wound on sizes ¾-in. to 2-in., and Type U20SCG with gray synthetic cover available from ¾-in. to 2-in. conduit sizes. It provides protection against moisture, dirt, oil, fumes, and chemicals. It is suited for applications requiring flexibility for connections in tight places, for connecting wires on machinery constantly operating in excessive oil or moisture, and for applications of extreme vibration.

*Universal Metal Hose Co., 2133 South Kedzie Ave., Chicago 23, Ill.*

# CRESCENT

## TYPE UF

### UNDERGROUND FEEDER and BRANCH CIRCUIT CABLE


***Also listed by Underwriters' Laboratories as***

**TYPE NMC – NON-METALLIC SHEATHED CABLE**

**Type UF Underground Feeder and Branch Circuit Cable was first adopted in the 1953 National Electrical Code. It is recognized in single conductor construction, sizes #14 to #4 A.W.G. inclusive and in two-conductor and three-conductor flat construction, sizes 14, 12 and 10 A.W.G. CRESCENT SYNTHOL TW thermoplastic compounds are used in insulation and jackets of these cables.**

**Multiple Conductor Type UF Cables are also listed as Non-Metallic Sheathed Cable, Type NMC, and may be used for both exposed and concealed work in dry, moist, damp or corrosive locations and in masonry block walls.**

*Licensed under Patent No. 2,663,775*




**Type UF single and multi-conductor cable is designed to be used underground, including direct burial, on feeders or branch circuits, when provided with overcurrent protection not in excess of the rated capacity of the individual conductors.**

***Send for Descriptive Bulletin***

**CRESCENT WIRE & CABLE**

OVER 70 YEARS EXPERIENCE

**CRESCENT INSULATED WIRE & CABLE CO.**

TRENTON, N. J.

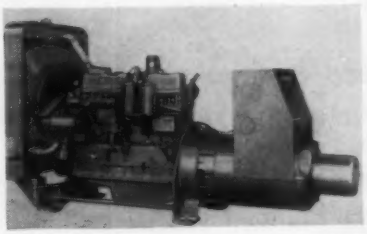
### Transition Motors (43)

A new transition polyphase motor line in the 1 to 5 hp range. To be built in the old frame sizes and dimensions of NEMA, the motors will incorporate all of the advanced engineering and insulation features of the new Tri-Clad 55 motor. The transition motors, to be manufactured for the convenience of those manufacturers who cannot take advantage of the new NEMA dimensions, will be available in most popular ratings at the premium prices already in effect for motors in the old NEMA frame sizes. The premium prices will give the motors the added features of Mylar polyester film insulation, G.E.'s Dri-film silicone water repellent core, solid cast rotors, advanced design for sonant operation.

*General Electric Company, Schenectady 5, N. Y.*


They are also Fleur-O-Lier approved. They are designed for rapid installation by means of adjustable U-bar hangers or jiffy clips. Lens and louvre frames are hung on concealed T-slot hinges, closed with a self-aligning thumb screw. Shielding materials are of metal, ribbed glass, acrylic plastic, flat or curved glass prismatic lens, and low brightness style lens. Catalog sheets are available.

*Metalcraft Products Co., Inc., Mascher & Lippincott Sts., Philadelphia 33, Pa.*



### Generating Plant (44)

A new emergency electric generating plant of 75,000-watt capacity has been designed for use in hospitals, hotels, hatcheries and theaters, public building and public utilities and for chemical plants and food processing plants. This high-capacity standby electric plant has a new generator that has been specifically designed to provide excellent electric motor starting. This characteristic makes Model 75HR ideal for standby installation in buildings and businesses where many electric motors provide essential power for other needs. In addition to standby service, this heavy-duty generating plant will provide dependable day-in, day-out service for such types of primary power jobs as construction lighting and power, for lumber camps and for small towns and villages when operated in parallel with two or more units. The new 75-kw, 93.75 kva standby electric plants are gasoline-engine-driven units which will provide either 75,000 watts of 60-cycle, ac, at 1800 rpm engine speed, or 60,000 watts of 50-cycle, ac at 1500 rpm.

*D. W. Onan & Sons, Inc., Minneapolis 14, Minn.*

### Lighting Fixtures (45)

A new line of recessed troffers designated as the "Aurora" line. These slim-line and rapid start troffers come in 2- and 3-lamp styles in 4-, 6-, and 8-ft units. They are available in open bottom type or with a choice of nine hinged shielding components. Aurora troffers are U.L. listed for use not only with series type ballasts but also with lead lag ballast.

### Veutilating Hood (46)

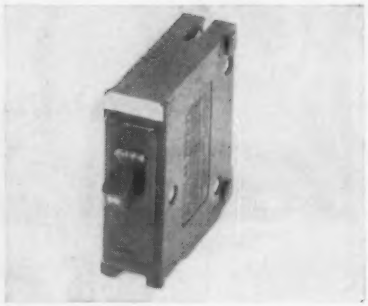
A new kitchen ventilating hood, Model S-350, is designed primarily for the smaller homes and multiple housing units. Hoods are finished in smooth baked enamel and equipped with 8-in. fan, two 40-watt lamps installed with switches for lights and fan, all assembled and prewired to one built-in pull box for easy installation. Two styles are offered: Aristocrat in white or copper for modern decor, and scalloped edge Provincial in copper enamel for Early American or ranch style. Sizes are 30, 36, 42 and 48 inches.

*Stanthony Corp., 5341 San Fernando Road West, Los Angeles 39, Calif.*

### Fittings (47)

A new line of "Tube-Weld" electric fittings for connectors, couplings and offset connectors. They are made of one piece heavy gauge welded steel tubing. Special case hardened screws have been so designed and inserted that all fittings surpass UL Pull Test requirements. An offset screw type connector for EMT has been introduced. It is made of tubing of a large inside diameter. The line uses rolled thread on the outside diameters of all fittings.

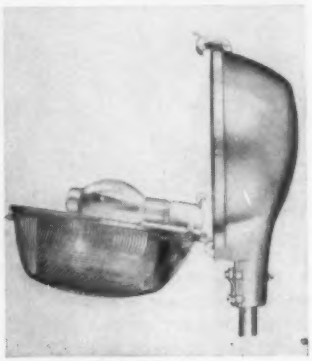
*Electric Tube Products, 74-16 Grand Ave., Maspeth, N. Y.*



### Circuit Breaker (48)

A new single-pole 120-volt, plug-in circuit breaker for circuit protection in lighting panelboards and load centers. With an interrupting capacity of 5000 amps, the Quicklag PL breaker is offered in five standard ratings between 15 and 50 amps. Circuit protection is based on a thermal magnetic trip which permits inverse time-delay tripping on slight overloads and instantaneous tripping on short-circuits and heavy overloads. After tripping, position of operating handle identifies the interrupted circuit. Other features include a quick-make, quick-break mechanism and non-welding silver-alloy contacts.

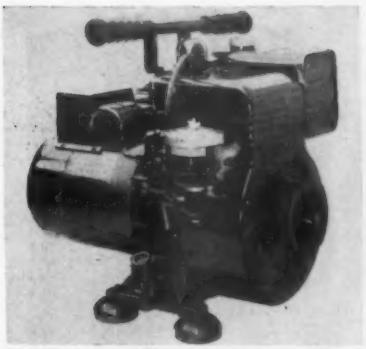
*Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.*



### Ovalite Luminaire (49)

New Ovalite luminaires with service-safe sockets for application to multiple or series, mercury vapor street lighting circuits. They are available with refractors for Type III or Type IV light distribution. The lamp and socket of each luminaire are parts of the hinged refractor assembly and are immediately de-energized and isolated from the circuit as the luminaire is opened. Ovalites with the service-safe feature for series circuits accommodate E-H1 and J-H1 lamps. These units are adaptable to horizontal or pendant mounting. A cast aluminum hood houses the Alzak-treated aluminum reflector and supports the hinged refractor. A spring-loaded latch and spring-loaded hinge hold the refractor securely against a water-repellant gasket to insure a bug-proof, dust-proof and weatherproof seal.

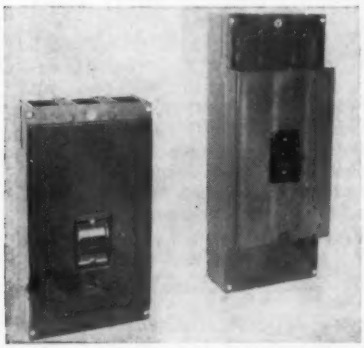
*Line Material Co., 700 W. Michigan St., Malwaukee 1, Wis.*



**Electric Plants** **(50)**

This new line of portable electric plants, called the Gen-A-Matic, includes 22 models in all, ranging from 275- and 500 watt, 6 and 12 volts to 4,000-watt, 120-volt models. Both ac and dc models are available with operating speeds ranging from 2800 to 3600 rpm. Engines used to operate all models at 4-cycle units. Engines and generators are matched as to capacity and engineered so that reasonable overloads can be handled. The line is designed to supply portable or standby power for every use—as the sole source of power where central station service is not available; as protection against power failure; for marine use; for operation of power tools on remote locations; and auxiliary lighting. Literature is available.

*Multi-Matic Corporation*, 14741 *Bessemer St., Van Nuys, Calif.*



**Circuit Breaker** **(51)**

A 400-amp molded-case air circuit breaker in the new KL frame size is available. The KL breaker is 6 inches shorter than the L breaker previously necessary for 400-amp applications, and ½-in. longer than K breakers. Providing automatic circuit protection for enclosures, switchboards, and panelboards, the breakers employ both thermal and adjustable magnetic tripping for overload and short circuit protection. Interrupting capacity is 25,000 amps at 600 volts ac, or 30,000 amps at 240 volts ac. Available ratings range between 125 and 400 amps at 600 volts ac or 250 volts dc. Two- and three-pole units are identical in size and are suitable for front and rear connection.

*Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.*


## Meters (52)

A new elapsed time meter has been added to this line of instruments. It is available in 2½-in. and 3½-in. sealed and bakelite cases conforming dimensionally to MIL specifications. Standard ratings include commercial voltages and frequencies with 5 digit registers reading total hours or tenths of hours. All sizes styled for perfect match with other panel meters in this line.

*Roller-Smith Corp., Bethlehem, Pa.*

## Bus Duct (53)

Bus duct with aluminum bus bars, is now available. It is 35% lighter overall than its copper counterpart, has double silver-coated aluminum bars to provide low resistance contacts as joints. It is available in ratings of 225 amps through 4000 amps ratings, Underwriters approved. The aluminum bars are put through a 12-step process which includes an acid dip and a zincate dip in addition to the strike, the electroplating, and various cleaning and rinsing steps. The plating process is designed to eliminate all possibility of electrolytic action.

*Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.*

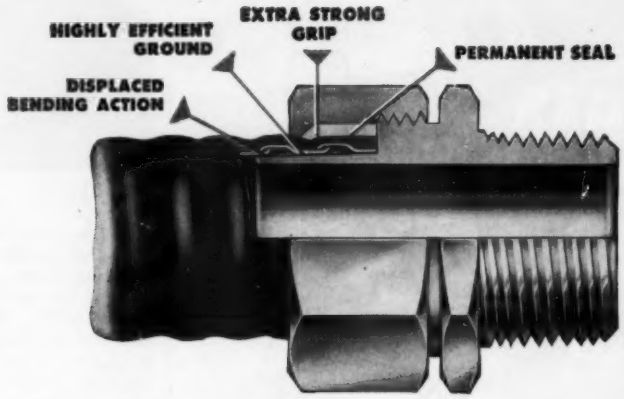
## Connector (54)

A new connector of Sealtite conduit designed to provide safe and dependable protection for wiring installations in this type of oil- and water-tight flexible raceway. It consists of a locknut and main fitting, a brass grounding bushing, a molded Neoprene gasket, and a hex gland nut. Locknut, main fitting and gland nut are made of malleable iron and hot dip galvanized. Connector is available in standard sizes from ½- to 2-in.

*Gedney Electric Co., RKO Building, Radio City, New York 20, N. Y.*

# it's new—an improved connector for liquid-tight flexible conduit

(Sealtite or equivalent products)




# PYLE-NATIONAL

## "CT" series Connectors offer all these advantages

### EXTRA STRONG GRIP

- Compression force is supported—not by the conduit alone—but also by the body shank, making a vise-like clamp.
- Gripping is well behind end of flexible conduit for firm anchorage against creeping loose.
- Pliable seamless sleeve makes a plastic-to-plastic grip with the conduit sheath... thereby avoids cutting and abrasion common to metal sleeves.
- High safety factor of compression range more than compensates for tolerance in the outside diameter of the flexible conduit.

### HIGHLY EFFICIENT GROUND

- Less than 10 millivolt drop.
- Tapered grounding shank, integral with connector body, makes a firmly wedged contact with the flexible metal conduit.

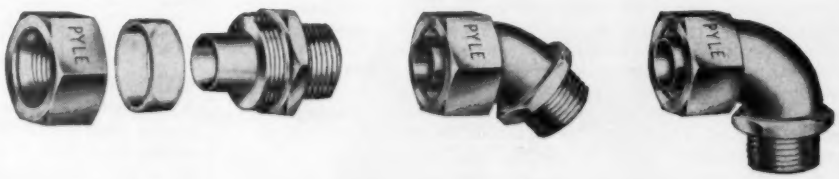
### PERMANENT SEAL

- Plastic sleeve and conduit sheath have equivalent physical characteristics therefore the seal will last the life of the conduit, unimpaired by temperature variations within the limits of the conduit.

### DISPLACED BENDING ACTION

- Tapered grounding shank is elongated to extend beyond gland nut, thus avoiding short radius bends which shorten the life of the conduit sheath and more important the permanency of the joint.

**"CT" Series connectors can be installed assembled... no parts to lose... no wasted time. Available in straight, 45 degree and 90 degree types for ⅜" to 2" liquid-tight flexible conduit. Meet U/L and J.I.C. standards.**




SINCE 1897

## THE PYLE-NATIONAL COMPANY

1344 North Kostner Avenue, Chicago 51, Illinois

Branch offices and Agents in the Principal Cities of the United States • Canadian Agent: The Holden Company, Ltd., Montreal

Export Department: International Railway Supply Company, 30 Church St., New York

PLUGS AND RECEPTACLES • GYRALITES • TURBO-GENERATORS • FLOODLIGHTS • CONDUIT FITTINGS • MULTI-VENT

### Meters (55)

Improvements have been made in two types of watthour meters—detachable mounting (DS) and bottom connection (DA). The overload capacity has been increased. For the 15-amp rating it is now 100 amperes instead of 60. A new 30-amp rating has an overload rating of 200 amps. These have been achieved by using heavier copper parts, solid instead of stranded wire in the current coil and by molding the whole coil in a heat-conducting insulation. Meter insulation has been improved and made more stable thermally. Both the potential and series coils can withstand 15,000-volt impulses. The socket-type meter has a De-ion arrester to protect it against lightning.

*Westinghouse Electric Corp.*, 401 *Liberty Ave., Pittsburgh* 30, *Pa.*

### Lever Control (56)

A new mechanical lever control has been made available for use with the Speed-Trol, variable speed transmission. It is a device for varying the output speed of the Speed-Trol by moving the lever through an arc. The lever arm can be positioned in any quadrant or rotated 180° about its axis and then locked into position. A speed setting indicator is available for use with this control.

*Sterling Electric Motors, Inc.*, 5401 *Telegraph Rd., Los Angeles 22, Calif.*

## Product Briefs

(57) The Eastern Specialty Company, Philadelphia, Pa., has introduced a new portable phase angle **meter.** . . . (58) Line Electric Company, Newark, N. J., has announced a new electric buzzer **paging system** complete in one package. . . . (59) A new 32 pole Series 805 direct current **relay** is available from Guardian Electric Manufacturing Co., Chicago, Ill.

(60) A complete line of ZEVA electric **soldering tools,** covering a range of 30 to 800 watts, is available from Paul C. Roche Co., Inc., New York, N. Y. . . . (61) Brook Motor Corp., Chicago, Ill., has announced that their single

*New*

**PROTECTION IN WIRE PULLING**

# RED THROAT

**INDENTER No. BM 21 B**

# CONNECTOR FOR EMT

***RED PLASTIC Bushing GREATLY INCREASES SAFETY and ECONOMY***


## NO INCREASE IN PRICE

**"BM" Connectors—Original Indenter Type**

| Cat. No. | Size | Pounds Per 100 | Carton Quantity | Standard Package |
|---|---|---|---|---|
| BM-21B | ½" | 7 | 50 | 500 |

| Net Price per 100 | | |
|---|---|---|
| Less Carton | Carton Quantity | Standard Package |
| $ 9.40 | $ 8.55 | $ 7.80 |

- Wagner BM Fittings are approved by Underwriters' Laboratories as concrete tight and comply with Federal Specifications W-F-406.

The protruding locked-in red plastic bushing serves a three fold purpose:

(a) Insures a smooth, burr-free raceway for easy fishing.

(b) Eliminates possibility of damage to insulation during pulling.

(c) Protruding lip prevents mechanical damage to locknut thread.

TELESCOPE BM SYSTEM

UL

**WAGNER MALLEABLE PRODUCTS CO.**

General Sales Office: 222 W. Adams St., Chicago 6, Ill.

Foundry and Plant: Decatur 60, Ill.

phase integral hp electric **motors** are now furnished with the starting switch on the outside of the motor. . . . (62) Pittsburgh Standard Conduit Company, Etna, Pa, has introduced **thread protectors** made of a durable polyethylene plastic, with a different bright color for each size of conduit.

(63) **Magnet wire** insulated with "Alkanex" is now being produced by the Construction Materials Division, General Electric Company, Bridgeport, Conn. . . . (64) Two new **smoke indicators** have been designed to meet local requirements over the country for installation on any size and type furnace; any type and grade fuel used: stoker or hand fired coal; oil burner; incinerator. They are manufactured by De-Tec-Tronic Corporation, Chicago, Ill. . . . (65) Telecom, Inc., Kansas City, Mo., has developed a **speaker phone** for two-way communication between a loud speaker and all telephones in any of the Telecom automatic dial systems.

(66) A new low-cost steel **scaffold** that provides platform heights up to 12-ft has been announced by Safway Steel Products, Inc., Milwaukee, Wis. . . . (67) "AlphaBlocks", Series N, a new type of sectionalized, hand-assembled **terminal blocks,** has been announced by Alpha Electrical Products Company, Little Rock, Ark. , . . (68) Cornell Dublier Electric Corp., South Plainfield, N. J., has developed a new circular **pole rack** design for power factor capacitors.

(69) A new type of striped and solid colored non-rigid thin wall Teflon **tubing** has been announced by Hitemp Wires, Inc., Mineola, L. I., N. Y. . . . (70) A new precision **indicator,** designed to scan a number of process variables by the use of a manual switching arrangement on the front panel has been announced by General Electric Co., Schenectady, N. Y. . . . (71) A new all-steel line of earthquake-proof **racks** suitable for all makes of storage batteries in emergency power applications has been developed by The Electric Storage Battery Co., Philadelphia, Pa.

(72) Hefty Holer, a new compact heavy duty **tool attachment** makes portable electric drill a power saw and nibbler. It is manufactured by Little Beaver Industries Inc., Willoughby, Ohio. . . . (73) The Louisville Ladder Co., Louisville, Ky., has announced an **aluminum ladder,** called the "American Standard," which conforms to the safety requirements of ASA's Safety Code for Metal Ladders. . . . (74) The Forsberg Mfg. Co., Bridgeport, Conn., has introduced a new 2-in. capacity **power saw** which rips and cross-cuts. It is known as Whiz-Saw Model No. 2.

(75) Dee Electric Co., Chicago, Ill., has announced a new silver **solder pot,** called Model 201, which features small

**Architect:**
Roger C. Kirchhoff

**Lighting Engineer:**
Albert M. Koga
Hub Electric Co.

**Electrical Contractor:**
Russell Hainstock
Havey Electric Co.

**Consulting Engineers:**
Robert E. Hattis

**Luminaires:**
Corning Alba-Lite

A main lobby in the University of Wisconsin Memorial Library. Drop bowls of Corning Alba-Lite create interest in the ceiling, prevent any feeling of "weight." Luminaires are easy to maintain.

Alba-Lite equipped luminaires blend in perfectly with the architectural scheme, enriching the various colors through warm, soft, complementing light. Each luminaire has four 75-watt lamps. Illumination level is 45 foot-candles and can be increased simply by installing lamps of higher wattage.

# **Complex requirements** determine choice of Alba-Lite in $5,000,000 University Library

How would *you* choose luminaires for key areas in one of the world's largest and most beautiful university libraries?

The architects and engineers set up a list of rigid lighting requirements for the University of Wisconsin Memorial Library. Against this list, they evaluated all possible choices to select the one that would best meet their standards.

When it came to luminaires for lobbies and corridors, the choice was large luminous elements with 24″ square bowls of Corning Alba-Lite.

Luminaires equipped with Alba-Lite possess the qualities of character and beauty required in a building so richly conceived. They are distinctive without being conspicuous—another key point on the architect's list. And they highlight the beauty of architectural design, besides having a look of "belonging."

**Pleased with results**

Alba-Lite filled the requirement of variation in light output without obvious difference in brightness. And, the luminaires also fit into the long-term picture of low maintenance cost. A wipe with a damp cloth keeps Alba-Lite looking bright and new. And there's never any discoloration or fading with age.

How would you summarize final results? The completion report said simply, "The architect was immensely pleased with results."

And that about sums up the opinion of everyone who is concerned with Alba-Lite installations. We'll be happy to send you complete information on beautiful, practical and versatile lightingware, if you'll just return the coupon.

**CORNING GLASS WORKS**
**CORNING, N. Y.**

*Corning means research in Glass*

**CORNING GLASS WORKS, Dept. EC-3, Corning, N. Y.**
Please send me a copy of the new Architects and Engineers Handbook of Lighting Glassware, LS-43.

Name.....Title.....
Firm.....
Address.....
City.....Zone.....State.....

size, portability and a replaceable ceramic crucible. . . . (76) A new machinery **mount**, for isolating low speeds and high impact applications, has been announced by the Barry Corporation, Watertown, Mass. . . . (77) A new type carbon filament decorative **lamp**, trademarked Candylbeme, is manufactured by North American Electric Lamp Co., St. Louis, Mo.

(78) A new silicone-controlled time delay **relay**, designated as Type A Silic-O-Netic Relay, is available with standard timings from ¼ to 120 seconds. It is manufactured by the Heinemann Electric Company, Trenton, N. J. . . . (79) A new 6-volt 5-amp tubeless magnetic amplifier regulated **power supply** has been introduced by the Perkin Engineering Corporation, El Segundo, Calif. . . . (80) A redesigned electrical circuit is now put in all single range and triple range **tachometers** manufactured by Metron Instrument Co., Denver, Colo.

(81) The Instrument Division of the Roller-Smith Corporation, Bethlehem, Pa., has announced a series of engineering and design changes in its line of sealed and ruggedized panel **instruments**. . . . (82) The Berko Electric Mfg. Corp., Queens Village, N. Y., has introduced a new glass portable **heater** thermostatically controlled and rated at 1250 watts, operating on 115 volts.

(83) Rockwood Pulley Mfg. Co., Inc., New York, N. Y., has added to the Croft line LTA and LTB Series fractional horsepower **speed reducers** in rating from 1/20 to 1 hp. . . . (84) The Wama Company, Baltimore, Md., has recently introduced a new process which silver plates all current-carrying parts in their line of "Add-A-Point" **terminal blocks**. . . . (85) A new line of **plastic electrical tape** has been announced by Behr-Manning Corporation, Troy, N. Y.

(86) A new adjustable **speed drive**, the Dynaspede coupling, has been developed by the Dynamatic Division, Eaton Manufacturing Co., Kenosha, Wis. . . . (87) The Port-O-Vox **wireless microphone** is a new communication aid for public gatherings, and for industrial control. It is manufactured by Port-O-Vox Corp., New York, N. Y. . . . (88) Ebert Electronics Corp., Queens Village, N. Y., has announced a new "Micrelay" electronic sensitive **relay** for control of high power, high current loads up to 60 amps or 3 hp from very low current, low power devices or circuits.

(89) Charles Engelhard, Inc., East Newark, N. J., is now producing new, improved **spirals** which are used for precise temperature measurement over the range minus 200°C to 550°C. A special high temperature resistance element encased in a ceramic envelope is available for measuring temperatures up to 750°C.

# CATALOGS and BULLETINS

(90) INSULATING MATERIALS of all types are listed in 32-page catalog 17. Descriptive data, available sizes and prices are included. Insulation Manufacturers Corp.

(91) FLUORESCENT LUMINAIRES for commercial and industrial use are discussed in a 28-page pocket size catalog which gives salient features of each style, mounting data and recommendations for application. Floodlights and incandescent units are also covered. Bulletin B-5799-B. Westinghouse Electric Corp.

(92) VOLTAGE REGULATOR designed for use with 60 cycle machines has no moving parts, no tubes. Bulletin T-8300, 4 pages, describes applications and operating characteristics. Inet Div. of Leach Corp.

(93) LIGHTING FIXTURES, including the exclusive Hap-E-Lite which provides a warm light needed for special residential and sales applications, are listed in 1955 catalog of ALKCO Manufacturing Co.

(94) TERMINAL BLOCK is rated at 70 amps, takes conductors from No. 14 to No. 4 inclusive. Design features and complete listing is given in 4-page folder. Buchanan Electrical Products Corp.

(95) ALUMINUM BUS is discussed in a 10-page booklet giving the properties, advantages, and methods of joining and bending rectangular and solid round bar, also tubular bus. Kaiser Aluminum & Chem. Sales, Inc.

(96) ALZAK FLOODLIGHT features peepsight for accurate aiming of its beam. Sheet 130-A describes various advantages of the aluminum Intenso unit. Price list TGL-1254 for lighting equipment is also available. Appleton Electric Co.

(97) UTILITY BLOWERS with backward-curved blades are non-overloading; available in direct- or belt-drive models. 48-page bulletin BC-11 gives complete technical data and dimensions. Hartzell Propeller Fan Co.

(98) LAMPHOLDERS of brass or phenolic construction are detailed in 8-page bulletin 154; design features of the Levolier switch are included. McGill Manufacturing Co., Inc.

(99) LAMP DATA on reflector and projector lamps in sizes up to 500 watts covers application and performance material such as approximate il-

lumination obtained at various distances from lamp and the size of the beam. CE-954. Westinghouse Electric Corp.

(100) ELECTRIC HEATING calculator estimates requirements for industrial or space heating applications. This special slide estimator fits in pocket, will give exact kw load when dimensions are inserted. Wiegand Co.

(101) OIL SWITCHES for subway installations are of the non-automatic type used for sectionalizing lines, switching transformers, and similar services. Bulletin 71B6101B, 4 pages, describes the M-25, a 300-amp, 5-kv unit and the M-50 which is rated at 400 amps and 7.5 kv. Allis-Chalmers Manufacturing Co.

(102) POLE LINE HARDWARE. New catalog features simple layout and removable pages; descriptive material on complete line. Electrical Mfg. Co.

(103) BATTERY CHARGERS. A full line of gasoline-powered units rated from 250 to 2200 watts are described in a 4-page folder; listings include three water-cooled marine models. Universal Motor Co.

(104) MOTOR CONTROLS, including magnetic starters and contactors, pushbuttons, and an extensive line of special switching devices, are covered in 46-page pocket Catalog 5411. Furnas Electric Co.

(105) TROLLEY BUSWAY for electrified cranes and hoists. Form 3457 illustrates the design features of the equipment and shows numerous installations. Feedrail Corp.

(106) HEATERS AND CONTROLS for soft-metal melting applications. GEA-6113 is a 4-page selection guide that covers cast-in immersion units and melting pots. General Electric Co.

# Books

### Annual Report of the Tennessee Valley Authority (107)

In this annual report of the TVA management to the President and Congress is included a complete review of the activities and the financial status of the TVA that will afford an excellent background on the subject. Supt. of Documents, U. S. Govt. Printing Office, Washington 25, D. C. 288 pp. $.70.

### Mechanical and Electrical Equipment for Buildings (108)

The section dealing with electrical installations in this third edition includes design and application data on wiring systems, lighting and machinery. Other chapters on air conditioning, acoustics and heating will be of particular benefit to the electrical contractor in understanding the basic problems of the other mechanical trades. By G. M. Gay, C. D. V. Fawcett and W. J. Guinness. John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 564 pp. $8.50.

### Bond Protection for the Supplier in the Construction Industry (109)

An outline of bonding requirements required by the federal government and each of the 48 states for public and private work. Each entry is followed by remarks on previous judicial interpretations of the statutes together with citations. Credit Research Foundation, 229 Fourth Ave., New York 3, N. Y. 90 pp. $3.00.

### Raw Materials for Electric Cables (110)

An intensive examination of conducting, insulating, and shielding material as to their physical characteristics and their application to cable construction. A. King, V. H. Wentworth and others. Ernest Benn Ltd., London, England., Distributed in U. S. A. by John De Graff, Inc., 64 West 23rd St., New York 10, N. Y. 362 pp. $7.00.

### Electricity—Direct and Alternating Current (111)

This is a second edition of a text directed to technical, nonprofessional courses of instruction. Starting with basic principles of electricity, the book takes the student through a theoretical and a practical examination of transformers motors and generators. By Charles S. Siskind, McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. 538 pp. $5.75.

### Interior Electric Wiring and Estimating—Part Two—Industrial (112)

Design and installation techniques for non-residential occupancies are surveyed. Direct reference is made to applicable sections of the NEC as it affects each subject. Lighting layout and estimating are covered with a step-by-step explanation of proper procedure. By Kennard C. Graham. American Technical Society, 848 East 58th St., Chicago 37, Ill. 324 pp. $4.95.

### Rewinding and Repair of Electric Motors (113)

This book was designed by its English author as a practical handbook for the motor repairman. Pure theory has been avoided and coverage intensified by considering only motors of 50 hp or less. By Karl Wilkinson. D. Van Nostrand Co., Inc. 250 Fourth Ave., New York, N. Y. 212 pp. $5.00.

EASY AS 1 — 2 — 3

(1) Insert wires into heavy-gauge bronze body and apply staking pressure

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(3) Screw on transparent plastic insulating cap -- the job is done . . . and you can SEE how you've done it.

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*New Another* T&B ENGINEERED *Design*

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tough, brightly-colored transparent insulating cap — screws on easily over body ears . . .

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you can see the job's done right

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- brightly-colored transparent cap catches the eye . . . permits visual inspection of joint
- a better, permanent joint that won't relax its grip
- *smaller, neater* joints for crowded boxes and outlets
- a *better* electrical joint at lowest possible installed cost
- unique ear design locks parts together to prevent loosening of cap by vibration
- wide range—approved for solid or stranded conductor combinations up to 3 — #12 AWG Max.
- installs with standard Sta-Kon tools as well as new Sta-Kon *plus* Pliers

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To install — use T&B's new

**STA-KON PLUS PLIERS**

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A top-quality tool, it is forged of carbon vanadium steel . . . has specially-shaped, blue plastic-cushioned handles for working comfort.

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# Reader's Quiz

**QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.**

## Methods for Checking Spot Welder

*QUESTION M27—Has anyone developed a way to check a 3-phase spot welder so that the operator may know every time he welds if he is getting the maximum current for each weld? We are welding a critical unit and every weld must be perfect. We do not wish to use an ammeter or oscilloscope or oscillograph.*—P.J.L.

ANSWER TO M27—An open core current transformer enclosing one secondary conductor, will have the ability to give fine results, if you use the secondary of the current transformer to drive a radio tube grid and then use the plate of that tube to stop the current.—H.S.

ANSWER TO M27—There are many things to be considered, such as material, time limit of weld, the pressure of the ram contact, width of weld surface, amperage required to produce the weld, and all this must be considered by the engineer or metallurgist.

Still there is the need of a guide, to maintain a common amperage usage of the individual job. An ammeter, oscilloscope or oscillograph, are good, but not dependable, whereas, if you have a Brush Analyzer-Amplifier and Recorder you can at any time check after each job the total amperage put (selected) thru each weld. You can keep a record of your jobs as reference.

The recorder comes into the weld time five to seven seconds before the weld period and shuts off after the weld period by three to five seconds. It thereby records the amount of amperage (current flow) in each and every weld made. Here you can see any deflection of current. You may have to adjust the selection of current taken from the transformer tap.

Should your job be very important, then by all means get a Brush Analyzer, Amplifier and Tape Recorder.—O.C.

## Cabinets for Housing Motor Starters

*QUESTION N27—To reduce labor costs, we have adopted the practice of using large transformer cabinets for housing motor starters, associated relays for limit switches used in electronically controlled apparatus. The starters and controls are removed from their factory enclosures and mounted inside the cabinet. This eliminates the hodge-podge of short nipples and fittings, as well as saving connecting time in installing small enclosures.*

*We provide practically the same spacing between starters and relays as would occur if they were nipple connected. One electrical engineer maintains that the thermal element heat ratings should be calculated on the basis of the original enclosure rating. Another says that the additional airspace allows heat dissipation and starters should be rated as installed "open" for heater settings.*

*Actually the ambient temperature inside the large cabinet was practically room-temperature when it was checked with a thermometer. Have other readers run into this same problem? What is the answer?*—L.W.F.

ANSWER TO N27—We have units installed in cabinets similar to yours and have found the "open" ratings give adequate protection in all except those units which have severe duty (operations of once a minute and more). Special provisions are made in these cases to keep the motors cool. It really is a problem of dissipation volume and my recommendation for your case would be to install heaters the next size under enclosure ratings.—C.H.Z.

ANSWER TO N27—I have run into this problem in steel mill and ordnance plant maintenance. I have used the manufacturer's listed thermal elements on basis of original enclosure, that is with normal temperatures. Allowances have to be made if starter or motor is at spot where above or below normal temperatures are encountered. In your case you can select thermal elements on basis of original enclosure.—W.E.G.

ANSWER TO N27—Heat dissipation is a controlling factor in thermal element controlled starters for motors. In one instance a magnetic switch located close behind a tempering furnace would trip after the furnace had operated for a short time. This happened with the cover on. After taking the cover off and checking the motor current, which was not excessive, it would not trip as long as the cover remained off so that the heat could dissipate, instead of remain in the enclosure. In another instance, a stream of cold water had to be run over the outside of a totally enclosed magnetic starter which in warm weather would trip with no apparent overload of the motor.—E.S.H.

## Vibration

*QUESTION P27—We installed a 15-hp squirrel-cage motor driving a blower on an air conditioning system. It was started across the line. The motor was mounted on concrete and the conduit to the motor was run overhead on the ceiling and stubbed down, and then a short piece of flex to the motor J box. When the motor was started and coming up to speed, the conductors in the conduit vibrated quite noticeably. When the motor reached running speed, the vibration ceased. The conductors to the motor were of the proper size, and the location of the conduit in respect to the motor was such that it was not subjected to the motor's normal vibration. Why did the conductors vibrate?*—G.R.G.

ANSWER TO P27—All materials have a natural vibration frequency of their own with some having a broad band while others with more solid molecular structure might have a narrow vibration frequency band at it's resonant frequency.

As the motor was coming up to full running speed it evidently passed through the frequency band of the conductors and set them in motion. Upon reaching running speed the motor was beyond the vibration frequency range wherein the vibration ceased.—J.B.K.

ANSWER TO P27—The motor on 220 volts would draw about 40 amps running current, and about 240 amps starting current. If there is enough room available in the conduit for the wires to repel each other then the wires will vibrate because like poles repel each other, unlike poles attract each other. At 240 amps we have enough torque. At 40 amps the torque is not enough. In this case two wires are of like polarity and one wire is of unlike polarity.—H.S.

## Motor Rewinding

*QUESTION Q27—I recently stripped a GE fhp, split-phase motor and found both the running and starting windings were wound with aluminum wire. I have not been able to locate any aluminum wire to rewind it with and I would like to change the winding to copper wire. However, copper and aluminum do not have the same resistance or current carrying capacity. Would you please tell me how I can determine the correct size of wire to use and if the number of turns should be changed.—K.E.D.*

ANSWER TO Q27—To the best of my knowledge, GE is at the present time the only motor manufacturer using aluminum magnet wire for motor windings. The motors are manufactured in GE's Ft. Wayne, Ind. plant. GE buys the bare aluminum wire from the three aluminum producers (Alcoa, Kaiser, Reynolds) and enamels the wire itself. Therefore, I recommend that you approach GE for aluminum magnet wire for rewinding their motor (they may ask to return the motor to them for rewinding but you should try, at any rate). A reconversion to copper would be an attempt to turn backward the wheels of progress. Aluminum will be used more and more, and the quicker you familiarize yourself with its characteristics, the better.—L.F.R.

ANSWER TO Q27—Note 1 of Tables 1 and 2 of the 1953 National Electrical Code states that aluminum wire shall be taken as having 84% of the current carrying capacity of the respective size of copper. Converting wire gauge size to circular mils and multiplying by 0.84 the equivalent circular mill area of copper is found. If the aluminum wire is of standard size however, the next smaller gauge copper will be too small, therefore just rewind with the same size wire. In either case use the same number of turns. The resistance is a small portion of the total impedance. In any inductive device the main consideration is the number of turns in the coil or coils.

If you are not rewinding for profit and have plenty of slot room as in some small motors without distributed windings you may wish to use one size larger wire and about 5% more turns per coil.—C.H.Z.

## Overheating of Motor

*QUESTION R27—The cause of overheating of a ½-hp 115-volt single phase motor has been traced to the rotor. The rotor, a standard type with bars*

*and fins of cast aluminum, tests ok on a growler. Is there some way to stop this overheating?—H.G.C.*

ANSWER TO R27—The heating in the ¼-hp 115-volt single phase motor referred to is in all probability caused by open or partially open bars in the rotor. H.G.C. stated the rotor checked O.K. on a growler, but did not state the type of test made. Growler tests for rotor trouble are sometimes misleading, especially the vibrator type tests. A more dependable growler test is the use of iron filings. To make this test, place a sheet of paper over the face of the growler and turn on the power. Sprinkle iron filings or cuttings (preferably cuttings from a cylinder boring job) on the surface of the rotor core. The filings will stick to the slots containing good bars. If a slot is found on which only a few or no filings stick, that slot contains a defective bar. Die-cast rotors sometimes have to be tested both when cold and hot.

The possibility of defective fields or centrifugal switch should not be overlooked in this case, as any cause of disturbance of the magnetic field will cause rotor heating. A "fluttering" or partially shorted switch or shorted or "bucking" fields will result in rotor heating.—J.A.

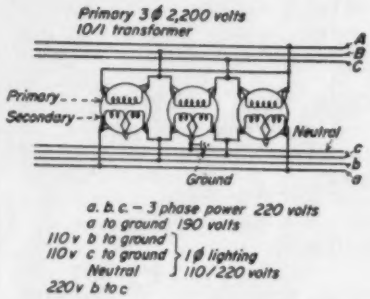
ANSWER TO R27—Check the air gap between stator and rotor. If this has been increased (motor repair shops have been known to turn rotors on a lathe to remove rust) overheating will result and motor current will climb sharply. It might be that the wrong rotor was installed. And a third possibility, worn bearings could have thrown the rotor off center increasing the air gap on one side, and decreasing it on the other. Air gaps must be carefully watched on alternating current machines.

It is assumed, of course, that a check has already been made to insure the starting winding is cut out when the motor comes up to speed, and that the main running winding is in good condition.—D.H.N.

## Wiring Problem

*QUESTION S27—In a system where 3-phase, 220, and also 110-220 single phase is taken from a delta-connected bank of transformers, why does the ground neutral to one leg show 220 volts, instead of being an odd voltage, as 180 or 260?—E.S.H.*

ANSWER TO S27—I cannot see how E.S.H. can get 220 volts to ground on the third phase of a delta connected bank of transformers.




a. b. c. – 3 phase power 220 volts
a to ground 190 volts
110 v b to ground
110 v c to ground } 1 ϕ lighting
Neutral } 110/220 volts
220 v b to c

The sketch shows the connections and voltages he should get from this type of conection. The 190 volts is the sum of the voltages of one and one half transformers divided by the $\sqrt{3}$ or 220 volts + 110 volts = 330 volts ÷ $\sqrt{3}$ = 190 volts.—D.S.V.

ANSWER TO S27—In a closed system, 220-volt, 3-phase, with the neutral of one transformer grounded to be used in a lighting circuit, the voltages from this ground to the 3-phase wires should be 110, 190, and 110. If the voltage from ground to one leg shows 220, that is a positive indication that one phase wire has become grounded instead of the neutral.—E.A.M.

## *Can you ANSWER these QUESTIONS?*

**QUESTION B28**—In the voltage regulator used on cars and trucks, what is the difference in construction between one marked positive ground or one marked negative ground?

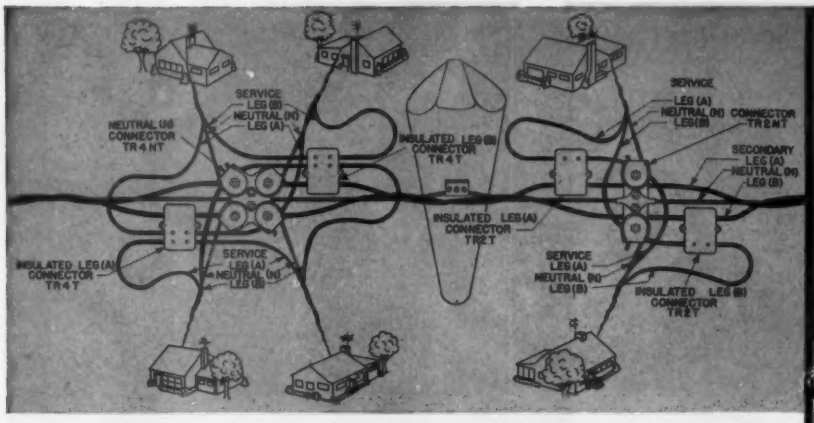
What instruments are necessary and how are these regulators adjusted?—V.W.B.

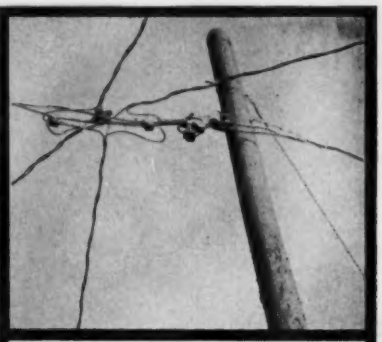
**QUESTION C28**—When checking motors for moisture, at what megohm reading would it be safe to operate 110-volt motors, 220-volt motors, 440-volt motors and also 2300-volt motors?—E.S.H.

**QUESTION D28**—What are preloaded ball bearings and how are they used?—D.H.N.

**QUESTION E28**—We have a totally enclosed bus duct which has been in service about 18 months. Recently we found that the bolts holding the insulated spacers in place have overheated to the extent that the insulators are badly charred. The only mechanical purpose of these bolts is to hold the insulator in place, not support the bus. Would brass bolts eliminate this or would fibre bolts be better?—H.G.R.

**PLEASE SEND IN YOUR ANSWER BY APRIL 15**



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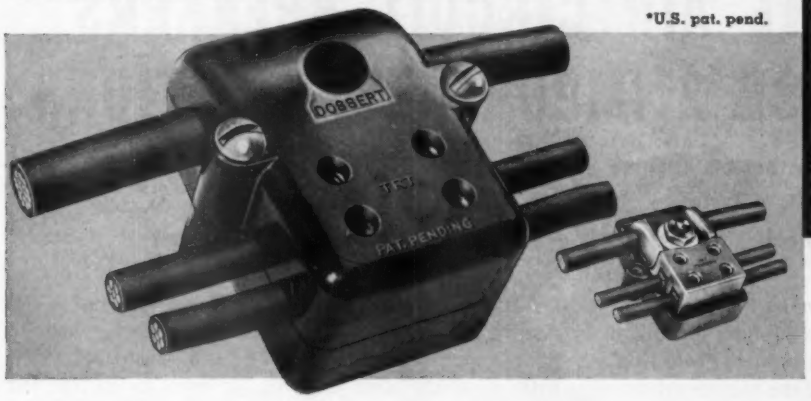
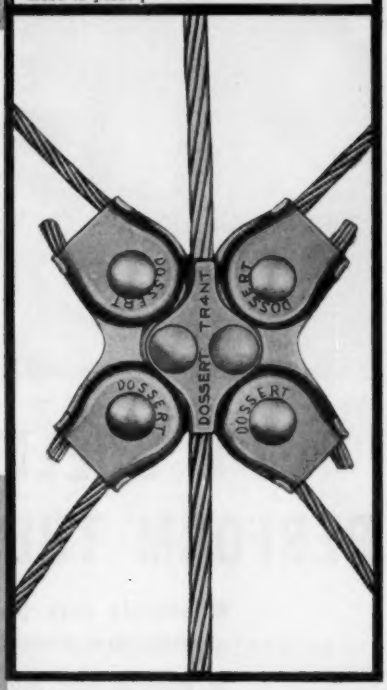
FOR SELF-SUPPORTING SECONDARY AND SERVICE DROP CABLE

*U.S. pat. pend.

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I-T-E Urelites are available through your local I-T-E distributor in four types of enclosures: general purpose, panel-mounted, weatherproof, and dustproof; and with auxiliary and tripping devices to fit specific applications. Ask him for literature or, if more convenient, write I-T-E Circuit Breaker Company, 19th and Hamilton Sts., Philadelphia 30, Pa.

I-T-E Type KA. 15,000 amp interrupting capacity. 15-225 amp continuous. 600 v a-c, 250 v d-c. 2, 3 and 4 pole.

I-T-E Type KB. 25,000 amp interrupting capacity. 40-600 amp continuous. 600 v a-c, 250 v d-c. 2, 3, 4 pole.

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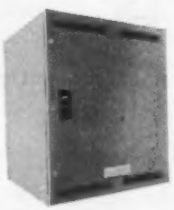


I-T-E Type LG. 75,000, 100,000 amp interrupting capacity. 2000-6000 amp continuous. 600 v a-c, 250 v d-c. 2, 3 pole.

**I-T-E**
**CIRCUIT BREAKER**
**COMPANY**
**SWITCHGEAR DIVISION**

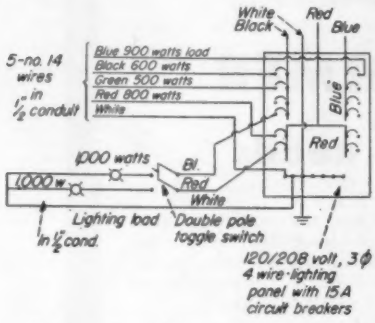
# Questions on the Code

*Answered by*

**B. A. McDONALD,** *New York Board of Fire Underwriters, Rochester, N. Y.*
**GLENN ROWELL,** *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
**B. Z. SEGALL,** *Consulting Electrical Engineer, New Orleans, La.*

## Multi-Wire Branch Circuit

**Q.** *Is the use of the double pole toggle switch in the manner illustrated good practice or permitted by N.E.C.? May the black and green wires in the top illustration be installed in an old conduit run 25 ft. long, one 90 ft. bend, all wires type TW thermoplastic?—C.J.*




**A.** I see no objection to the use of the two pole switch shown in your diagram provided it is rated for the voltage of the circuit and the current and the nature of the load it controls. If the lighting load in question consisted of fluorescent lamps, the switch shown must be rated at 250-volt 20 amps, since a switch controlling an inductive load must have an ampere rating twice the ampere rating of the load. See Section 3814 of the Code. It appears to me that the rating of a so-called "toggle switch" would not satisfy these requirements.

The Code recognizes by Table No. 4 only four No. 14 conductors in a ½-in. conduit. Table No. 11 however makes an exception to this rule as follows; "For rewiring existing raceways for increased load where it is impracticable to increase the size of the raceway due to structural conditions". In this case the conduit may contain as many conductors as 50% of its cross-sectional area permits. The area of ½-in. conduit is .30 sq. ins. 50% of this area is .15 sq. ins. The area of five No. 14 TW conductors is .0675 sq. ins. It is therefore evident that 5 No. 14 conductors, Type TW could be installed in a ½-in. conduit but it is very important to see that the conditions involved with the exception are satisfied.

I also note you have a total of four circuits connected to the one neutral. This is in violation of Section 2111 covering multi-wire branch circuits. This Code provision recognizes a 3-phase, 4-wire circuit with a neutral common to each phase wire provided there is a potential difference between each of the phase wires. In the example shown there is no difference of potential between the black and the green conductors.

The use of the green covered conductor also is in violation of Section 2112. This new provision in the 1953 Code, (last paragraph) prohibits the use of green covered conductors for other than grounding purposes.—B.A.McD.

## Flexible Conduit

**Q.** *May we use sealed tight flexible conduit for the flexible connections to the motors on a hammer mill in a grain elevator?—T.J.B.*

**A.** Under Section 3512 you will note that flexible metal conduit of the liquid-tight type is permitted in a hazardous location described under Article 5054, which covers Class 2 locations and inasmuch as a feed mill or grain elevator contains Class 2 locations, the Code will accept the use of liquid type flexible metal conduit provided it is used where it is not subject to mechancial injury or temperatures in excess of 140 degrees Fahrenheit.—G.R.

## Underground Service

**Q.** *We want to install two insulated and one bare (neutral) wire for underground service from the utility co. pole to customer service on building. It is single phase, 3-wire, 120/240-volt.*

*Local inspector will not accept bare neutral, quoting Article 230 section 2303B.*

*We claim the exception given under 2303b (and 2303a) covers the use of bare neutral in this case. All parties have agreed to abide by your interpretation.—W.D.M.*

**A.** Section 2303b (and 2303a) does cover this problem. The first sentence of 2303b by reference to 2303a does permit bare underground service neutrals where the voltage to ground is 300 volts or less. However the second sentence states (and seemingly in contradiction) that "Service conductors (without distinction as to phase or neutral lines) installed . . . shall be lead covered . . ." In my opinion the second sentence is meant to apply only to those service conductors which are insulated and the word "Insulated" maybe should be inserted at the beginning of this requirement.

However, Section 1110 would apply and in certain cases the inspector may require a fully insulated neutral especially if the conductors will be buried directly in the ground without a conduit or duct enclosure.—B.Z.S.

## Overcurrent Protection

**Q.** *On a lighting job I am now installing, I wish to use some of the new type of panels using plug-in breakers and want to know whether or not it is necessary that I place 200-amp overcurrent protective devices ahead of each panel as I would prefer to use the new panel having the 400-amp bus to supply a number of 20-amp circuits fed by single phase 3-wire feeder.—O.C.S.*

**A.** Under Section 3883 you will note that panelboards equipped with snap switches rated at 30 amps or less shall have overcurrent protection ahead of them. However, nothing is said in this section concerning the panel equipped with breakers except that under paragraph a. of this section it does state that where the conductors supplying the panel have overcurrent protection greater than 200 amps, the panelboard shall have a rating at least that of the overcurrent protective devices protecting the feeder conductors. Therefore, if your overcurrent protection at your point of supply for the

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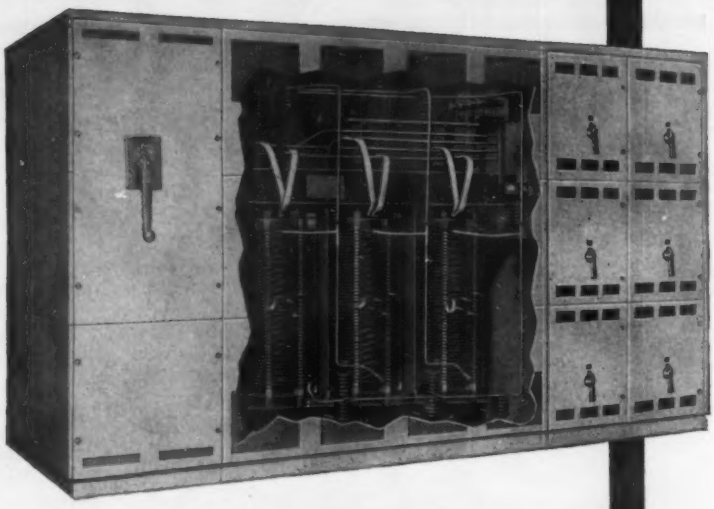

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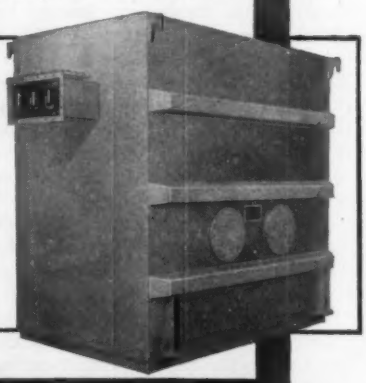

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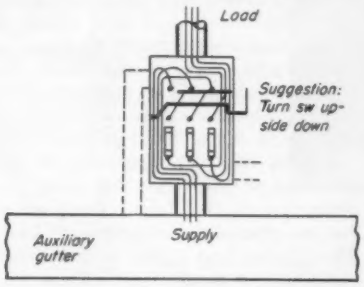
feeders supplying this 400-amp panel are 400 amps or less, it is not necessary that you provide additional protection on the feeders at the distribution panel.—G.R.

## Switch Enclosures

**Q.** *A problem which often arises concerns the method of bringing large conductors into switch enclosures. The question is not important in small switches but very much so in large ones. Suppose the switch shown in the illustration is fed from beneath as shown, but the load conduit goes up overhead. Then the tap conductors from the gutter must go through the switch to the top and the load conductors must go from the bottom and out the top, making six conductors filling the switch. As before mentioned, in small switches, the problem is not important, but recently we had a 400-amp switch with 500MCM conductors*




*and to get them in was very difficult and in my opinion anything but workmanlike in appearance. When the switch is opened or shut one or more conductors are rubbed by the switching apparatus. To mount the switch upside down would completely take care of the problem and since the switch is held open or shut by strong springs I cannot see any violation of the Code rule governing the mounting of knife switches. However I have never seen such an installation although I believe it far more satisfactory than the way it is now.—G.R.G.*

**A.** I believe many of us at times have experienced a similar reaction with respect to your observation on this question. I have found with some designs of switch enclosures that the wires may be installed without difficulty or crowding the conductors. On others it is difficult to obtain either a workmanlike or safe installation. In the latter case I believe the inspector would be justified in requiring the conductors feeding the switch to enter the box at the top and leave at the bottom as shown by the dotted lines. Such procedure, however, would be cumbersome. It appears, however, that some of the combination fuse and switch devices properly mounted in a cabinet could be used to advantage in such cases. Switches mounted below the gutter would tend to eliminate the congestion especially where the load served is below the position of the switch. I do believe that careful planning the installation would eliminate in some cases the conditions shown by your diagram. I agree, however, that many switches are wired as shown and that the wires in some cases are unduly crowded and are subject to mechanical injury by the switch mechanism. When such conditions prevail there is a violation of Section 3003 of the Code which covers the protection of conductors from mechanical injury and I feel that an inspector should criticize such installations on this basis.

While the mounting of the switch in an upside down position would eliminate the conditions in the case shown, I do not believe that such a method of procedure should be considered. As you state there would be a violation of Section 3806 of the Code which prohibits the placing of a switch in a position where they could accidentally close by gravity. Switching mechanisms may become defective and switches not properly maintained could easily fall by gravity when a spring or its fastening failed. If such procedure were to be recognized it appears that a locking device, as now required for double-throw switches, would be essential. Personally, I believe that careful planning of an installation coupled with the use of adequate switch enclosures will eliminate to a considerable degree the conditions presented by your problem.—B.A.McD.

## Paralleling Conductors

**Q.** *Would the paralleling of two 800,000 circular mil conductors per phase be considered a serious Code violation?—R.C.G.*

**A.** It is my personal opinion this would not be considered a serious Code violation. However, I do believe it would be a serious engineering mistake to parallel two 800,000 circular mil conductors because of the amount of copper per ampere necessary in the larger sizes. Section 3105 of the Code provides for the multipling of conductors in sizes 1/0 to 500,000 circular mil inclusive, and where two 800,000 circular mils are paralleled for each phase, additional copper is required per ampere making it unrealistic to use the larger conductor and therefore in my belief the code committee felt it unnecessary to provide permission to parallel conductors larger than 500,000 circular mils. If you care to figure this out, you will find you can carry 25% more amperes per pound of copper on a 500,000 versus an 800,000 circular mil conductor—G.R.

## Combination Loads

**Q.** *Will you kindly outline the various code rules involved with a motor installation consisting of the following 3-phase induction motors: 10-hp, 7½-hp and 2—1½-hp and 20 kw single phase, 115-volt lighting load. I would like to see how the feeder and feeder fuse is computed and also the size of branch circuits, conductors, fuses, disconnects and motor heaters.—G.J.P.*

**A.** The following applies to the motor design.

Assume all are 3-phase, 220-volt, standard squirrel cage, 40 degree rise, across the line starting and Code letter H.

1. Average full load currents (Table 24)

10 hp—27 amps
7½ hp—22
1½ hp— 5

2. Main feeder for motor (Section 4314)

10: 1.25 x 27 or 33.75 amps
7½: 22
1½: 2 x 5 10

Total 65.75 amps

3 No. 6 RH (Table 1) in 1" Conduit (Table 4)

3. Individual branch circuits for each motor (Sec. 4312)

10: 1.25 x 27 or 33.75
3 No. 8 RH (Table 4)
¾ in. conduit (Table 4)
7½: 1.25 x 22 or 27.5 amp
3 No. 10 RH in ¾ in.
1½: 1.25 x 5 or 6¼ amp
3 No. 14 RH in ½ in.

4. Motor overcurrent protection (running protection usually thermal relays, heaters, etc in controller Section 4322). Since the same 125% factor applies for this as it does for the individual branch circuit size calculation, the maximum rated thermal elements, etc, shall be for each

10 hp: 33.75 amps
7½ hp: 27.5
1½ hp: 6.25

5. Maximum rating of branch circuit overcurrent protection. Table 26 (also see Section 4343) shows for these motors and Code letter H a maximum of 300% for fuse rating, therefore for

10 hp: 27 x 3 or 81 amps—use 100-amp block with three 90-amp fuses
7½: 22 x 3 or 66 amps—use 100 amp block with three 70-amp fuses
1½: 5 x 3 or 15-amp—use 30-amp block with three 15-amp fuses

6. Main motor feeder protection (Section 4362)

| | |
|---|---|
| 10 hp: | 27 x 3 or 81 |
| 7½: | 22 |
| 1½: | 2 x 5 or 10 |
| | 113 |

Use 200-amp switch with three 125-amp fuses.

The following pertains to the lighting load. Assume this to be 115/230 single phase. The full load current would be

$$\frac{20 \times 1000}{230} \text{ or } 87 \text{ amps}$$

Use 100-amp switch with two 90-amp fuses.

Use three No. 3 RH in 1¼ in. conduit.

If these two loads will be fed from separate services then the above calculations are complete. If a combination service is to be used, since many utility companies like to feed each customer with a single service and thus have a single meter, then we can serve this customer with a 4-wire, 240-volt, delta service. This is obtained by increasing the size of one of the transformers in the delta bank to take care of the single phase load also, and using the center tap of this larger transformer for the neutral for the lighting load. The lighting load is thus fed only from two phases of the three phases.

| | |
|---|---|
| Motor feeder | 113 amps |
| Lighting (2 phases) | 87 |
| | 200 amps |

The main switch would be a 200-amp size with two 200-amp fuses in two phases and one 125-amp fuse in the third phase.

Two main service lines would be 3/0 RH, one would be No. 6 RH and the neutral would be No. 3 RH. The service conduit calculations would be:

Area: 3/0 2 x .4151 or .8302 (Table 13)

| | |
|---|---|
| 6 | .1238 |
| 3 | .1817 |
| | 1.1357 |

Table 11 shows conductors may occupy 40% maximum of the conduit area, therefore minimum conduit area must be 1.1357/.4 or 2.839. Third column of Table 12 shows 2 in. conduit.

The above shows the general calculations. There are many other rules that may be applied, as for example the 1½-hp motors could be placed on a single branch circuit in accordance with Section 4343a. Also, hermetically sealed motors are more involved, as can be seen from Sections 4304b, 4309b, 4383e and 4403b.—B.Z.S.

## Appliance Branch Circuits

**Q.** *With regard to the number of outlets on an appliance circuit in a dwelling occupancy: Some seem to think that in 2116 under the heading of "other outlets" the 1.5 amps would determine the number of outlets on such a circuit, as for example; 20 ÷ 1.5 = 13.3 outlets.*

*There are others who say that there is no limit according to the Code because the sign ‡ in front of other outlets refers you to the fine print which reads as follows;*

*"‡ This provision not applicable to receptacle outlets connected to the circuits specified in paragraph-b of Section 2115-b etc."*

*Others claim it depends on the appliances used. What is the correct answer?—J.M.*

**A.** Section 2116 of the Code covers the requirements for calculating the load for lighting and appliances on a branch circuit. In a dwelling occupancy the lighting load is computed on the basis of 3 watts per sq ft and the number of circuits required is obtained by dividing the total wattage by the voltage of the circuit and then dividing the resulting amperage by the ampere rating of the circuit used. On such circuits there is no limit to the number of lighting outlets which may be connected. See 2115-a—paragraph 2.

In connection with the receptacle outlets installed in a dwelling occupancy, Section 2116-a-1, paragraph 3 reads as follows: "All receptacle outlets of 15-amp or less rating in single-family and multi-family dwellings and in guest rooms of hotels (except those connected to the receptacle circuits specified in paragraph b of Section 2115) may be considered as outlets for general illumination, and no additional load need be included for such outlets. The provisions of paragraph b of this section shall apply to *all other receptacle outlets.*" This requirement might be interpreted as indicating that the number of receptacles on an appliance branch circuit must be computed on the basis of 1.5 amps per circuit as covered by 2115-b. This however, in my opinion, is not the case. Section 2115-b, as you have pointed out in your question, definitely advises that the 1.5-amp per outlet does not apply to the receptacles connected to the appliance branch circuits required in a residential occupancy.

In support of this opinion Section 2115-b provides that one or more 20-amp appliance branch circuits shall be installed in a residential occupancy. The load for such circuits is computed

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on the basis of 1500 watts per circuit and not on the basis of 1.5-amp per outlet (See 2203-c-1). The first sentence in Section 2203 also indicates that the 1.5-amp outlet does not apply to a dwelling occupancy.

In view of the foregoing I believe that the Code does not limit the number of receptacles that may be placed on an appliance branch circuit by applying the 1.5-amp provision. It appears to me, in considering this question, that the electrical committee based this Code provision on the premise that the average dwelling occupant would use the appliances ordinarily available and common to such locations. Many of such appliances are portable and used for short periods of time.

They recognized the fact however that more than one circuit might be needed and I believe that any inspector who finds from field experience that present day usage indicates that one circuit is inadequate would be entirely justified in requiring an additional circuit or circuits.

The question of the rating of the appliance used also enters the picture. As the use of roasting ovens, ironers and other appliances of similar ratings continues to increase, it is evident that the ordinary appliance circuit is not adequate for such loads. At the time of inspection it is difficult for an inspector to estimate the loads that may be connected to an appliance branch circuit. It therefore appears to me that we have reached a point in our expanding electrical development where it is essential that the minimum requirements for one appliance branch circuit be increased to two or more.—B.A.McD.

## Switch Boxes

**Q.** *I have recently been told I can no longer use conventional switch case boxes to mount ordinary duplex convenience outlets where I feed through from one outlet to the other with three conductors so the top half of the outlet can remain hot and the bottom half can be switched. The new inspector claims this places too many wires within each box and that it is prohibited by the Code. Is this true?—D.C.*

**A.** Under Section 3709 you will note that for each No. 14 conductor there shall be at least 2 cubic inches of free space within a box and even though a conductor is fed through a box without being cut. If it is attached to the terminal screws of a wiring device it is considered as two conductors. Therefore where you are feeding through these boxes with

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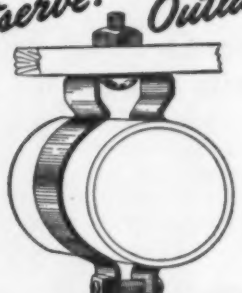



three conductors, you actually must consider them as six conductors within each box. As the average switch wall case box has a little over 10 cubic inches, you can see the maximum number of 14 conductors would be only 5 if the box contained no wiring devices or cable clamps. Inasmuch as it does contain wiring devices, it is necessary the number of conductors be further reduced. You will note in this same section that where fixture studs, cable clamps or hickeys are mounted in a box, the number of conductors shall be one less than shown in the tables with a further reduction of one for each flush device or combination of flush devices mounted on the same strap. Therefore, if the wiring installation in question is in conduit and your boxes contain no cable clamps, you would be limited to four conductors in each such wall case box. If instead of using No. 14 conductor you are using No. 12, you will note that 2¼ cubic inches is required for each conductor terminating in a box. If you wish to use a box having a dimension of 1¾ by 2¾ inches to mount these duplex convenience outlets, it will be necessary that you use one at least 3 inches deep in order to have proper wiring space within it for the six conductors.—G.R.

## Derating Conductors in Raceways

**Q.** *Does the NEC arbitrarily derate more than three conductors in conduit or is the derating value based on conduit fill as stated in Tables 8, 9 and 10 of the Code?*

*The Code permits six 4/0 wires in 3-in. conduit. Anticipating a larger load in the future, I installed 3½-in. conduit. This gives me 1.58 sq. in. more area than required, about ½ more than the 3-in. would have. May I raise the 20% derating factor by ½ or must it stand?*

*Part 2 — If three No. 14 control wires were pulled with the above 4/0 in 3½-in. conduit, would they all be derated 30% (more than six wires in conduit) with or without the possible ½ increase above the 30% derating?*—R.D.O.

**A.** Since the 1951 or 1953 editions of the N.E.Code contain no Table No. 8 or No. 10, it will be necessary for me to visualize the question you have in mind. According to note No. 4 following Tables No. 1 and 2 of the Code, conductors in a raceway or a cable which contains from four to six conductors will have a current carrying capacity of 80% of the values shown in the tables and this percentage is decreased to 70% when seven to nine conductors are so installed. This provision first appeared in the 1940 edition of the Code and was the result of an intensive investigation over a period of years by a group of technical experts in this particular field. You will note under the heading of Table No. 1, that the values of the current carrying capacities of the various types of insulated conductors which are shown are based on a maximum of three conductors in a raceway or cable. Since each conductor carrying current produces heat, it follows that the total amount of heat produced by an assembly of conductors will be in proportion to the number of conductors involved. It therefore follows that the derating values are not arbitrary but are based on sound engineering principles supported by test and field experience. At the present time a special committee appointed by the Electrical Committee of the NFBA is investigating and obtaining data from actual field installations which will be used as a basis for establishing derating values for raceway installations that contain more than nine conductors. This question is not covered by the Code.

In answer to your second question, there is no provision in the Code which would recognize a discount of the derating percent due to the use of a larger conduit size. A type R-0000 conductor has a current carrying capacity of 195 amps when installed in a raceway containing not more than three conductors. This means that an assembly of three conductors operating at 195 amps each would produce a temperature rise above the ambient temperature of 86° F to approximately 140° F which is the maximum temperature at which the Type R insulation may safely operate. When six conductors are installed, it is necessary to derate the carrying capacity so that the cumulative heat produced by all six conductors will be equivalent to that produced by three conductors. While the size of the raceway involved could influence the heat produced, it appears impracticable to cover in the Code all of the conditions which to a minor degree have some influence on the heating effect. Another question could be raised with respect to ambient temperature below 86° F. Perhaps a table of correction factors should be established for such conditions of operation. Personally I do not believe this to be essential and I doubt if it were established that it would be used much.

The answer to the third question appears to be covered by Section 7265 which recognizes the remote control conductors without any further penalty. Such conductors however must satisfy the requirements of Section 3011.—B.A.McD.

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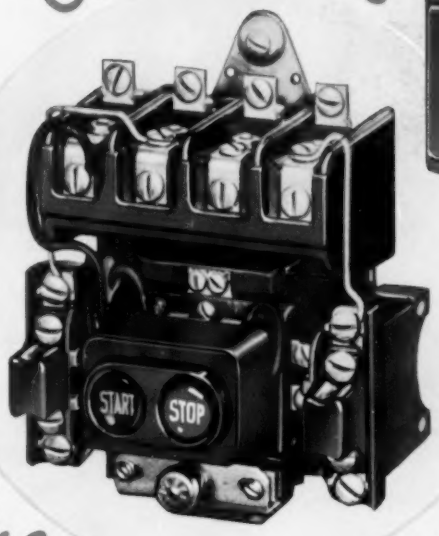


Bulletin 709—Form 1

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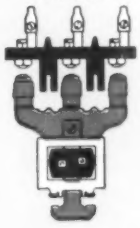
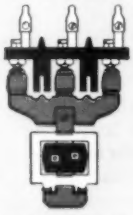


CONTACTOR CLOSED



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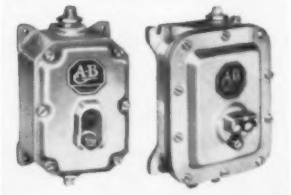
For continuous plant operation, specify either Bulletin 609 manual or Bulletin 709 solenoid starters. For maximum protection to man, motor, and machine, the Bulletin 709 is best. Its "no-voltage" protective feature prevents accidental restarting of motors after power interruptions. Write for the A-B Handy Catalog —6th Edition.

**ENCLOSURES** for Every Operating Condition



NEMA type enclosures are available for Bulletin 609 and Bulletin 709 starters to satisfy any operating requirement.

Allen-Bradley Co.
1316 S. Second St., Milwaukee 4, Wis. • In Canada—
Allen-Bradley Canada Ltd., Galt, Ont.

# ALLEN-BRADLEY

MANUAL AND AUTOMATIC STARTERS

QUALITY

2-55-RM

# A QUALITY STARTING SWITCH for SMALL MOTORS

## *Providing Reliable Overload Protection*


With linkage lever & pilot light.

With standard lever & pilot light.

3-Way selector & pilot light.

With removable key switch.

NEMA Type 7 enclosure for hazardous dust or gas conditions.

NEMA Type 4 enclosure for watertight & weatherproof service.

## BULLETIN 600 MANUAL STARTER

### for Motors of 1 Hp or less

This compact toggle switch with a built-in overload breaker satisfies the National Electrical Code (Para. 4322 sub. C) covering overload protection requirements for motors of 1 hp or less.

QUICK MAKE & BREAK CONTACTS—The simple, rugged, over-center mechanism has a quick make and break action. No "teasing" of contacts means long contact life.

GENEROUS WIRING SPACE—Cover slips off, exposing front and both sides.

ATTRACTIVE APPEARANCE—The clean, modern lines are a sales asset to any machine. Enclosures listed for every service.

Allen-Bradley Co.
1316 S. Second St., Milwaukee 4, Wis.

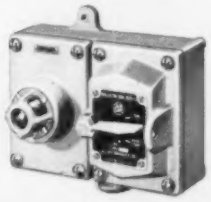
In Canada—
Allen-Bradley Canada Ltd., Galt, Ont.

**ALLEN-BRADLEY**
**TROUBLE FREE MOTOR CONTROL**
QUALITY

Flush mounting of two Bulletin 600 starters, each with a pilot light.

In a standard switch box.

In a surface mounted box.



NEMA Type 4 enclosure with pilot light for use in wet locations.

2-55-RM

# Practical Methods

## Heat Pump Cuts Hog Farrowing Costs

FARM ELECTRIFICATION

One of the first applications of a heat pump to animal husbandry requirements is the installation in the hog farrowing barn at Eli Lilly's 1,290-acre, Conner Prairie Farms at Noblesville, Ind. According to Tillman Bubenzer, farm manager, the unit was installed so management could have control over farrowing barn temperature regardless of outside weather conditions. Now multiple farrowing can be planned and conducted year-round instead of seasonally, and valuable barn space is utilized to the utmost. He also noted greatly increased swine production, lower initial investment and operational costs and reduced fire hazards as outstanding advantages of the unit.

The heat pump operates on a reverse-cycle refrigerator principle. In winter, the Freon refrigerant passes through an outdoor coil, picks up heat from the air and carries it to the indoor coil, and the resultant heat is circulated throughout the building. During the summer, the process is reversed with the refrigerant in the indoor coil extracting heat from the building air and dissipating it through the outdoor coil.

During the winter, the fully automatic unit maintains a minimum temperature of 65 degrees in the farrowing barn. Summer temperature is maintained at 72 degrees. A duct system distributes the air throughout the barn. D. H. Fisher, in charge of swine production, believes the health of the swine has been improved by having draftless, uniform and constant heat and cooling. Insects, dust and odors have been all but eliminated and a reduction in swine fatalities due to disease has been noted. The new temperature control also allows early weaning, at two or three weeks, and so turnover of sows is greater. Through elimination of much of the care formerly needed, labor costs have been cut considerably, Fisher reported.

The Westinghouse heat pump is located in the loft of the farrowing barn where it takes no more space than an average size furnace. Installation was made by the Illingsworth Construction and Engineering Company of Indianapolis.

**DUCTS IN FARROWING BARN** distribute air heated in winter and cooled in summer by heat pump located in loft above. Controlled temperature and humidity increases swine production. If needed, supplemental heat for new-born pigs is provided by suspended heat lamps.

## Foremen's Record Room Helps Job Cost Control

MANAGEMENT

Management at Edling Electric Company, Moorehead, Minn., electrical construction firm, believes in accurate job costing. For purposes of job control, estimating, and accounting, they want to know where every hour of labor and every dollar of material cost is spent. To secure this information, particularly on small jobs, they have the job foremen report to the shop headquarters at the end of each day to record time and material used on each project. Hasty notations on backs of envelopes or scraps of paper or cardboard are not acceptable. The data must be listed on time slips and material sheets provided for this purpose.

**JOB FOREMEN RECORD** time and material spent on their jobs at the end of each day in a special room designed for their use at Edling Electric Company in Moorehead, Minnesota. Pigeon-hole shelf contains forms and active records. Work orders hang on arches below. W. W. Sharp (extreme right) supervises operation of system.

To facilitate maintenance of this job cost system, Edling has provided a Foreman's Record Room under the supervision of assistant manager W. W. Sharp. The long, narrow area has a continuous work table along one wall where the men can sit and make out their reports. Above the desk area is a pigeon-hole shelf—one opening for each foreman—which contains active working records and a stock of record forms. Under each pigeon-hole is an arch-board on which are hung work orders assigned to the men. Each man's name appears on the shelf above his desk area.

The foremen come into headquarters each morning to pick up their new work orders and check those of work in progress. At the end of the day they return to fill out their time and


# FACT:
# SAME-DAY DELIVERY on 13,584 Electrical Items

WESCO is a *national* distributing organization with 118 local offices in principal cities. In any one of its many warehouses you'll find 16,000 electrical items . . . to meet your immediate demands. Quality products, with names you know and trust. These are facts you should know.

### 85% of All Orders Shipped Same Day

It's also a fact that deadlines have to be met and emergencies handled on the spot. WESCO fills over 85% of all orders with "same-day" delivery. Call your local WESCO office in the morning, and your order . . . large or small . . . will be on its way that afternoon. Call late in the afternoon and the order will be shipped the next day. *And,* when needed, trained specialists are available to help you solve those tough jobs.

### One Dependable Source

Dependability like this, from ONE responsible source, makes your job easier . . . no need to stock normal electrical maintenance and repair items for months at a time.

You'll find WESCO listed in the yellow pages of your classified telephone directory . . . under the heading Electrical Supplies, Wholesale and Manufacturer. Give us a call. You'll be glad you did.

## WESTINGHOUSE ELECTRIC SUPPLY COMPANY

material sheets for these jobs. The active material sheets in the 11 pigeonholes match the work orders suspended underneath. When a job is completed, the foreman places his work order, time slip and material sheet in a basket at the end of the long table. Sharp then checks the completed orders before sending them to the clerical department for pricing and billing.

Both the foremen and Edling management agree that this system works well for the variety of electrical work done in the shop and they plan to stay with it until a better scheme is developed.

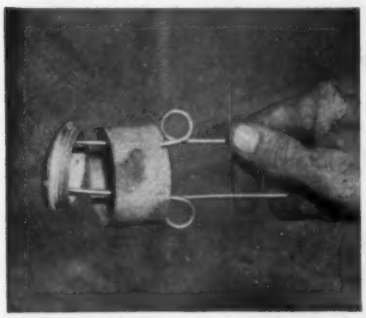
## Wire Gripper Holds Floor Outlet Flange

INSTALLATION

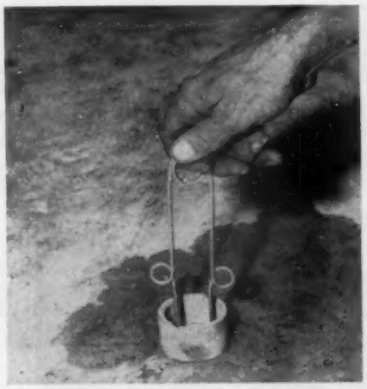
Mechanic ingenuity on electrical construction projects can frequently save time and money for the contractor. It may involve only a few minutes or seconds per operation, but on a sizable project the total can add up to an item of considerable magnitude.

This was true on the electrical installation at the new office building of the South Dakota Highway Commission at Pierre, S. D. A Fenestra-NEPCO cellular floor system (cellular steel load-supporting structural panels) was used throughout the new building and provided the raceways for branch circuit conductors. This required the installation of several hundred floor taps to bring conductors out of the cells at specified outlet locations.

Each floor tap consisted of two basic parts: a male outlet flange (with an oval shape flange) which was inserted into the deck opening; and a threaded sleeve which turned on the flange to lock both securely to the floor panel. An extension sleeve and closing plug could be added if necessary.



**SLEEVE AND FLANGE** are placed over lower prongs of wire gripper. Bent tips at end seat in holes in flange section; keep it from turning or dropping into floor cell.



**GRIPPER HOLDS** inserted flange securely against bottom of floor while 2-in. diameter sleeve is threaded tight against deck. Unit is removed by squeezing prongs together to retract bent tips from flange holes.

John May, foreman for Baumgartner Electric Company (Rapid City, S. D.), project electrical contractor, quickly solved the problem of inserting and holding the flanges while tightening the floor tap sleeve. He took an ordinary spark lighter (used for igniting gas torch tips), removed the flint and turned the wire tips outward to form a handy gripper.

To assemble the tap, May squeezed the gripper, slid the sleeve and flange (in that order) over the lower end of the prongs, then let the prongs spring out until the tips were seated in two holes in the flange section. After inserting the flange in the deck opening, he held it in position with the gripper while he used his free hand to thread and tighten the sleeve. A quick squeeze on the gripper prongs released the unit before it was removed from the installed floor tap. The entire operation was completed in a matter of seconds and May reports amazingly few flange sections were "lost" or had to be fished out of the deck cells.

## Aluminum Brazing Improves Product

MANUFACTURE

The Aluminum Products Company of Texas, manufacturers of double-hung aluminum window frames, has found that brazed joints are stronger, cheaper and quicker to make than mechanical joints, and that minimum training of employees is required for the obtaining of high-grade workmanship.

Several other methods were experimented with before the present procedure was adopted, including the use of argon and helium as an inert gas. The present technique is to jig the frame parts in place after the area to be brazed has been cleaned and degreased; paint brazing flux along the joint; heat until the flux becomes a liquid; then applying the brazing rod until sufficient material has flown along the joint. After brazing, the frames are cleaned by a 5-minute bath in engraver's nitric acid solution having a 35% solution strength. Water is then used as a second washing agent and, finally, the frames are sprayed with a clear lacquer.

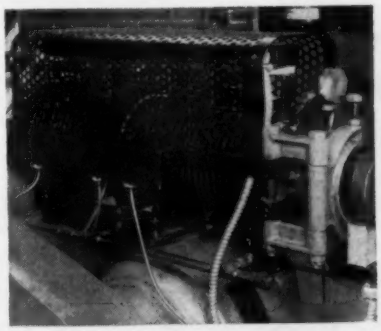
Products used in the process include All-State No. 31 sheet aluminum brazing rod and Brazaloy flux, a Victor oxy-acetylene torch with a No. 3 tip, pipe jigs and standard working racks. Since low working temperatures are possible with this rod and flux (1050 degrees F), there is little danger of burning the aluminum stock and, since the flux changes its form and appearance at the instant of proper heat, workers have a visual signal by which to gauge their operations.

None of the girls employed for this work has had previous experience in this type of industry, yet the technique was quickly learned so that joints now have a neat appearance and have proved as strong as the base metal.

## Electric Heat Provides Uniform Extrusion Temperature

PROCESSING

For many years manufacturers of plastic and rubber extruding machines had difficulty obtaining adequate, uniform temperature control on the extruding cylinders of their units. This problem came to a head at the Standard Machinery Company of Mystic, Conn., designers and builders of extruding machines, with the installation of a 4½-in. Davis-Standard machine for



**TEMPERATURE CONTROL** jacket clamps around the extruder core of an extrusion machine. Combination of cast-in electric heaters and water-cooling tubes permit precise temperature control and maintenance of uniform cylinder temperature.

**PRE-FORMED** electric heating elements are placed, with water cooling tubes, in lower part of mold in which control unit is cast.

extruding garden hose. When the unit was operated, sudden hot spots or upshoots to 100°F would occur over about two-thirds the length of the extruding cylinder toward the delivery end. This burned the compound and the damage sometimes went unnoticed until the hose was inspected.

Standard engineers evolved a theory that a combination of electric heating elements and water-circulating tubes would provide uniform temperatures throughout the cylinder. Subsequent tests and experiments proved this approach to be correct and the Davis-Standard "Therma-Fin" temperature control unit became a reality. It is a finned-aluminum jacket cast in two halves with tubular electric heaters and stainless steel water tubing cast integrally in the two halves. Both heaters and tubing are bent serpentine fashion, with turns and straight-aways parallel to each other.

The jacket is clamped around the extruding core of a machine to provide precise, positive temperature control over the extrusion cylinder at all times and to maintain a uniform temperature. Field experience indicates that an extruder equipped with this electric heat control can successfully extrude a wide variety of materials. Previously a separate extruder was used for ordinary rubber, another for thermo-plastics and another for room-temperature rubber.

## Portable Stand Holds Plug-In Floodlights

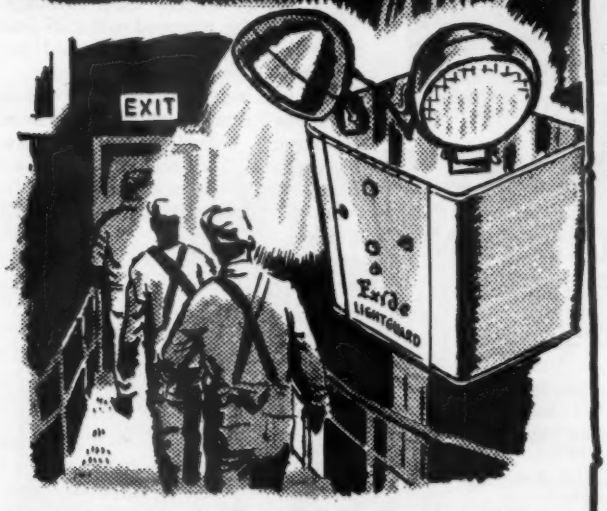
**ILLUMINATION**

A shop-made portable stand holding three swivelling floodlight sockets has many uses at the Star Supermarket in Cambridge, Mass. Constructed by

# FACTS ABOUT Exide®

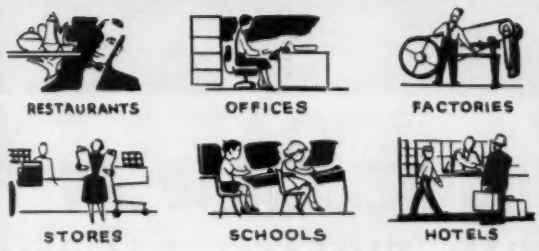
## EMERGENCY LIGHTING SYSTEMS

## WHEN LIGHT MEANS LIFE
## DEPEND ON EXIDE EMERGENCY LIGHTING!


## WHEN LIGHTS GO OUT...
## EXIDE-LIGHTGUARDS® GO ON!

WHENEVER STORMS, FLOODS, ACCIDENTS OR FIRES CAUSE UNEXPECTED POWER FAILURES, COMPACT, PORTABLE EMERGENCY LIGHTING UNITS FURNISH LIGHT INSTANTLY AND AUTOMATICALLY! THEY PREVENT PANIC, INJURIES, PROPERTY DAMAGE, LOOTING!




## HUNDREDS OF PROFIT-MAKING SPOTS

EXIST IN YOUR COMMUNITY - IF YOU SELL EXIDE LIGHTGUARD PROTECTION! WHEREVER PEOPLE GATHER, WHEREVER SUDDEN DARKNESS CAN BE COSTLY, YOU CAN SELL COMPACT, PLUG-IN EXIDE LIGHTGUARD UNITS. THEY LIGHT UP INSTANTLY, AUTOMATICALLY, TO PREVENT PANIC, INJURIES, PROPERTY DAMAGE AND THEFT.

### MAIL THIS COUPON NOW

EXIDE INDUSTRIAL DIVISION
The Electric Storage Battery Company
Philadelphia 2, Pa.

YES . . . I want to cash in on emergency lighting sales. Rush details on new Exide Lightguard units.

Name_____

Address_____

City_____ Zone____ State_____

My business is: ☐ Electrical Contractor ☐ Consulting Engineer ☐ Architect ☐ Distributor ☐ Electrical Engineer ☐ Dealer

**Exide INDUSTRIAL DIVISION,** The Electric Storage Battery Company, Philadelphia 2, Pa.

**THREE PAR LAMPS** in a cluster can be adjusted to focus well over 200-foot-candles of concentrated illumination on local areas for critical seeing purposes. Substitution of floodlights for spotlight lamps provides reduced light over a wider space. Unit was designed and fabricated by electrical maintenance department of Star Supermarket in Cambridge, Mass.

Star's electrical maintenance department, the unit consists of a heavy square steel base plate, sturdy pipe flange, 6-foot pipe section and cap holding a cluster of PAR lamp housings. The unit is also equipped with a 25-foot heavy-duty rubber-insulated cord for plug-in purposes.

This unit has been of great service in numerous instances when maintenance of motors, unloading of materials, checking of delivered products or cleaning of premises calls for concentrated high-level illumination in small areas.

## Plug-In Wiring for Flexible Shop Layout

**CONSTRUCTION**

When Frank Ross moved his Ross Electric Motor Shop into new and larger quarters in Fairmont, Minn., he insisted that the wiring system be economical and still give a measure of flexibility to permit any future shop layout. He wanted to be able to shift departments and equipment, as necessary, without becoming involved in extensive wiring.

With this in mind, he specified the installation of 20-amp., 250-volt, 3-phase, grounded receptacles mounted on the roof steel structure. Four-prong, twist-type plugs with right-angle cord connectors support flexible cord connections to motorized equipment and work benches below. Outlets are spotted so they can take care

# WHAM and it's fastened in steel or concrete with the new

# Creary "330" Drive-It

A fastening every 15 seconds with ease! The new Creary "330" DRIVE-IT is the fastest cartridge-powered fastening tool on the market. It will save you time and money . . . reduce your on-the-job costs.

**NEW Creary "330" DRIVE-IT** fastening large steel switchbox to concrete wall in Anchorage, Alaska with *Creary* threaded *Drive-pins*.

## Here are 8 reasons why you'll want a Creary Drive-It

**1. SNAP-OPEN ACTION** for fast loading and ejection. Greatest operating speed of any cartridge powered tool.

**2. REQUIRES ONLY ONE STANDARD POWER LOAD** for all fastening jobs. No need to buy different strength cartridges for each job.

**3. TWO CARTRIDGE-POWERED TOOLS** for light or heavy jobs. The new Creary "330" Drive-It (.25 cal.); heavy-duty "410" Drive-It (.38 cal.)

**4. AUTOMATIC CARTRIDGE EXTRACTION** when breech is snapped open. Gives more fastenings per minute.

**5. SAFETY IN FIRING,** as Drive-It must be pressed firmly against the work surface before tool can be fired.

**6. STEEL ENCASED RUBBER GUARD** completely surrounds work area, another of the many safety and convenience features which make Creary Drive-It the choice of contractors everywhere.

**7. BARREL EXTENSION** allows fastening in recessed areas such as junction boxes, deep channel iron, and other confined spaces.

**8. CREARY DRIVE-PINS** are U.L. approved, will penetrate up to an inch of structural steel and withstood a 10,000 lb. pullout test by Pittsburgh Testing Laboratories.

**Start reducing your fastening costs today.**

**SEND FOR FREE CATALOG . . . ask for a free demonstration.**

PLEASE PRINT

**Powder Power Tool Corp., 7532 S. W. Macadam Ave. Portland, Ore.**

**Name** _____

**Address** _____

**City** _____ **Zone** _____ **State** _____

**Type of Business** _____ ☐ **Want a Demonstration**

**FLEXIBLE SYSTEM** of plug-in outlets serve power and lighting requirements of this motor repair shop; permit quick and easy rearrangement of equipment. Power receptacles are 20-amp, 250-volt, 3-phase, grounded type. Four prong, twist-type plugs have right-angle connectors to add neatness to cord drops.

of practically any anticipated arrangement of equipment. The same system is used for lighting.

Now, when a department is shifted, Ross merely unplugs the equipment cords and replugs them at the new location. To date he has encountered no need for circuit extensions nor long, unwieldy flexible drop cords.

With this completely flexible system of wiring, even major change in shop layout requires no down-time.

**PORTABLE HYDRAULIC CRANE,** operated by a hand lever, is a handy piece of materials handling equipment found on many of Harlan Electric Company's (Detroit) electrical construction projects. Unit has ½-ton capacity and is used extensively to move and set motors, circuit breakers and other bulky equipment. U-shaped frame (on casters) straddles conduit stub-ups and motor bases. Boom-arm is raised by hydraulic ram.

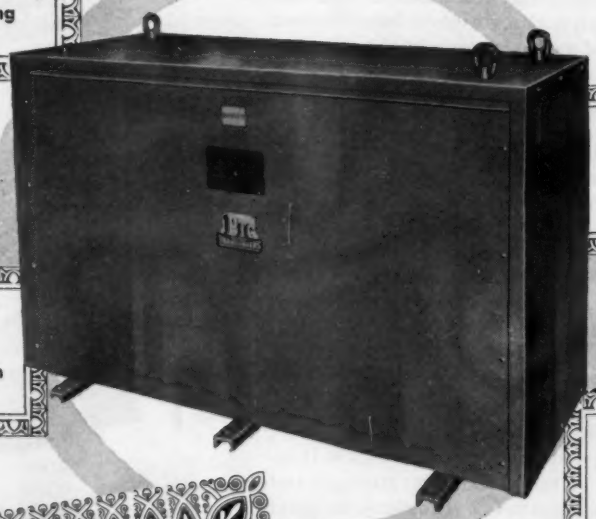
# PRECISION on your transformer is more than a name ...it's a guarantee!

## PRECISION ...

**the only transformer backed by a 5-year guarantee! Only Precision offers this important long-range protection . . . your assurance of superior design, material and workmanship. Reduce costly repair work . . . power failure worries . . . work stoppages! Be precise — install Precision.**

### *Full Rated Load*

**Carry full loads continuously . . . capable of handling emergency over-loads.**



### *Dependable*

**Ruggedly constructed to exceed latest NEMA standards!**

### *Economical*

**Low initial cost . . . inexpensive operation and maintenance.**

### *Quiet*

**Unsurpassed for smooth, silent operation.**

### PRECISION 5 year GUARANTEE

Manufactured products bearing the trademark or nameplate of this company have been thoroughly inspected and are guaranteed to be free from defects in workmanship or materials. The Company's liability under this Guarantee is limited strictly to replacing without charge or repairing upon return to the factory, transportation charges prepaid, any part or parts which within five (5) years from date of shipment from our factory, shall be found to have defective workmanship or material or shall otherwise fail to meet specifications. We are not responsible for repairs or replacements made by others without our written authorization.

### *Easy to Service*

**New handy panel board gives quick access to all taps.**

SINGLE AND 3 PHASE

**¼ to 1500 KVA . . . Voltages to 15 KV.**

**Available with any make switchgear in substation units.**

***Write today for FREE Catalog and valuable technical data charts.***

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*For easier application...*

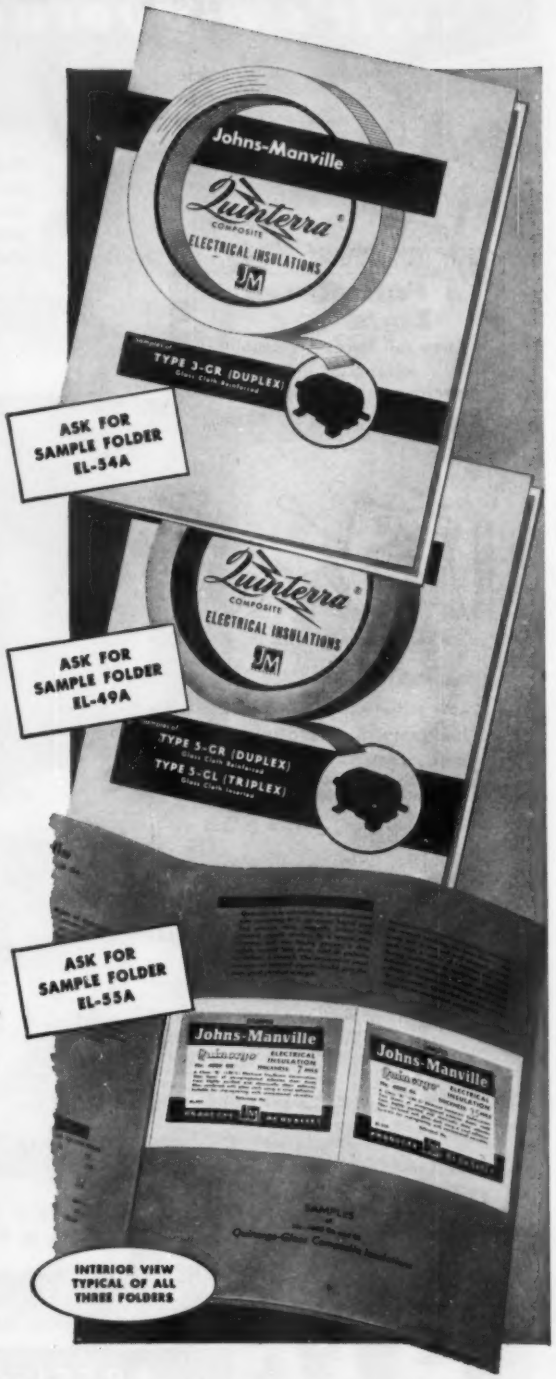
# New *Quinterra*® and *Quinorgo*® Composites provide high mechanical strength

**Samples of these Johns-Manville purified asbestos electrical insulations now available for testing by manufacturers and motor repair shops**

**Quinterra Type 3-GR** is a Class H electrical insulation, good for operating temperatures up to 250C. It is constructed of a silicone-saturated purified asbestos sheet with a backing of smooth, tightly woven glass cloth. Type 3-GR combines exceptional tensile and tear strength with the highest humidity and pyrolysis resistance of any asbestos type insulation.

**Quinterra Type 5-GR and Type 5-GL** are premium quality Class B purified asbestos electrical insulations treated to resist operating temperatures up to 150C. Both have exceptional tensile and tear strength, with lasting dielectric strength. Type 5-GR (duplex) is one sheet of Type 5 bonded to one sheet of glass cloth, Type 5-GL (triplex) is one sheet of glass cloth between two sheets of Type 5.

**Quinorgo No. 4000-GR and No. 4000-GL** are economical Class B purified asbestos electrical insulations with exceptional tensile and tear strength and thermal stability. No. 4000-GR (duplex) is glass cloth backed with Quinorgo 4000. No. 4000-GL (triplex) is one sheet of glass cloth between two sheets of Quinorgo 4000. Both are untreated and readily absorb commercial insulating varnishes.




**SAMPLES OFFERED WITHOUT CHARGE**

These sample folders with description of the electrical and physical properties of Quinterra and Quinorgo composites are available from your insulation distributor. Or write Johns-Manville on your company letterhead indicating which type or types you desire. Address Johns-Manville, Box 60, New York 16, N. Y.; In Canada, 199 Bay St., Toronto 1, Ontario.

**Johns-Manville ELECTRICAL INSULATIONS**

# In The News

## Maintenance Men and Contractors Swarm to Chicago Conference

Nearly 20-thousand enthusiastic delegates converged on Chicago's new International Amphitheatre for the January 24-27 Plant Maintenance Show and Conference, where 37 conference sessions were presented by 53 recognized speakers, 9000 separate items of equipment were exhibited by 445 manufacturers and service organizations, and where 2300 of the delegates sat in on the many factual, practical, down-to-earth discussions of maintenance problems.

The majority of these sessions had a strong electrical flavor, covering maintenance of electrical distribution equipment, lighting installations, electronic control devices, power and materials-handling apparatus. Sessions also included discussions of union-management problems, preparation and use of training manuals and other maintenance aids, modern safety devices and practices, human relations in both large and small plants, organization of maintenance forces and effective maintenance techniques.

In officially opening the conference, General Chairman L. C. Morrow, consulting editor of *Factory Management & Maintenance*, gave a clear indication of the present importance of industrial maintenance, stating that approximately 1,334,000 employees in American manufacturing plants (approximately 8.3% of the entire manpower listing) are now engaged in maintenance work. He also estimated that this huge maintenance force receives around $5.4-billion annually, while around $4.86-billion is spent for maintenance supplies and equipment. Together, therefore, America will spend over 10 billion dollars in 1955, and this estimate is considered to be on the conservative side.

Morrow declared, "You maintenance people thoroughly understand that lower costs can mean lower selling prices and greater consumption. You know the value of large scale production in securing lower costs, and hence the importance of large consumption. Therefore you concern yourselves with methods, procedures and equipment that make for uninterrupted operation, minimum waste, minimum cost. You constitute a powerful force dedicated to keeping the plants of this nation in strong competitive positions. And the fact that thousands of you attend this conference every year is strong evidence that maintenance has reached a point of recognition equal to that held by production, administration, engineering, sales and labor."

Spaced through the conference program were three sessions of general interest; the subject for the first one being "What does management expect from a maintenance program, and what does a maintenance department want from management?"; the subject for the second being "Planning and scheduling — their advantages and limitations in large and medium sized plants", while the third general session tackled the problem of "Managing the maintenance organization". All three of these sessions were panel presentations, with outstanding authorities on these subjects representing all phases of industry and all sections of the country.

In addition to the three general-interest sessions, eight topical conferences were held concurrently, as were 16 round-table discussions. And, complying with requests from delegates at former conferences, the majority of these sessions were slanted towards the electrical field.

For example, in discussing "Maintenance and Construction of Plant Buildings", engineer W. E. Chandler of Monsanto Chemical, Saint Louis, Mo., stated that, "in an attempt to provide adequate lighting in aisles and open areas, lights have frequently been mounted in extremely inaccessible positions, although there is now a tendency toward the use of directional lighting mounted in easily-accessible locations. This is particularly helpful in plants where mass light bulb replacement is practiced. And, from a fire hazard standpoint, separate disconnect switches should be installed for each building of a large plant, with the switches located on the outside of the building."

On the subject of "Control of Maintenance Activities through Standardization and Labor Measurement", Frank Pierson and Edmund Newton of the Atlantic Refining Company in Philadelphia jointly mentioned that "some people have the wrong idea that

**GETTING THE FACTS** about a new lightweight conduit bender is John Waters (left) of Lange Engineering Co., Chicago elecrical contracting firm. Allan Geddes, Greenlee Tool Co., explains features of 15-ton, aluminum-alloy, one-shot hydraulic bender with two-speed hand pump at Plant Maintenance Show in Chicago.

**MOTOR SHOP FOREMAN** L. R. Pilotte (left) and electrical supervisor Samuel Tupycia (right) of the Ford Aviation Engine Division plant, Chicago, talk shop with Roy Blersch, The Martindale Electric Co., Cleveland, Ohio.

**VISITING THE NISA** booth at the Plant Maintenance Show in Chicago to relate motor shop experiences are: (L to R) M. B. Hesse, Hesse Electric Co., Waukegan, Ill.; Arthur Wagner, Arthur Wagner Co., Chicago; Ivan Pixler, Al Johns and Donald McQueen of the Pixler Electric Co., Spencer, Iowa.

maintenance work is unpredictable, although we have found that 85% of our own work is either predicted or anticipated. Our preventive maintenance is based on the philosophy that it is cheaper to anticipate a breakdown rather than wait until it occurs. We have also found that our maintenance costs have decreased through standardization of methods, procedures, tools, materials and equipment; plus pre-planning and measurement of unit time values for all typical operations. The results of this standardization have been gratifying, and our manpower utilization (i.e., planned vs actual) is averaging 95%. We also believe that planning was the cause for saving 334 man-days (approximately $8350) during a recent shut-down."

In discussing "Organization of the Maintenance Force", plant engineer G. Russell Carpenter of the Minneapolis-Moline Company, Minneapolis, stated that, "In this day of electronics and automatic machines, the electrical maintenance department is becoming more and more vital to production, for this department maintains all motors and electrical equipment, switchgear, lighting installations, unit space heaters, ad infinitum. In this connection, we have found that the organization should be physically centralized as much as possible in order to minimize the amount of necessary filing, clerical help, shop and locker space, tool inventory and the like."

Analyzing "Maintenance Cost Control", plant engineer Lester Leach of the Dennison Manufacturing Company, Framingham, Mass., mentioned that, "Our maintenance department is controlled, and its effectiveness is measured, by cost and operating budgets, efficiency and work orders, work loads and overtime, delay studies and reports. At regular intervals the actual cost of maintenance is compared with estimated standards, and variations are studied closely. These estimated standards are based on a 10-year analysis of machine repairs and we have found that the extent of machine-repair manhours can be closely predicted by production machine-hours of service. Production machine-hours, in turn, are reflected by our power consumption, and our man-hour distribution closely follows this power-consumption curve. The efficiency of the department is figured by comparing actual time spent on each job to the estimated time which the foreman or supervisor has allowed. It is surprising that, over a long period, we have been able to divide our crews into three groups by this means; one group operating below 90%, another group operating between 90% and 100%, and the third group working between 100% and 120%. Over a 3-year period we have found that the same men and the same groups hit these same percentages."

The question, "What's Good and What's Bad about Preventive Maintenance", was answered by plant engineer Herbert Johnston of the Philco Corporation in Philadelphia. In his talk he declared that, "This subject has formerly been treated on the basis of pros and cons, that is, breakdown vs prevention, too little or too much paper work, etc. That is not really the point, for maintenance should be a balanced proposition: balanced thinking, objectives, policy, application. You should also consider simplicity, moderation and common sense. As a basic policy, we have four broad maitenance objectives: to prevent production downtime, abnormal physical depreciation, fire and safety hazards, and high maintenance costs. Our frequency of inspection and maintenance is governed by study of past failures, diagnosis of trouble and prognosis of future repetitions. And our diagnosis has shown that most troubles can be traced directly to friction, fatigue, stress, corrosion, maladjustment misalignment, vibration and poor housekeeping. Therefore, these are the things we try to lessen through maintenance."

***"Work Measurement"***

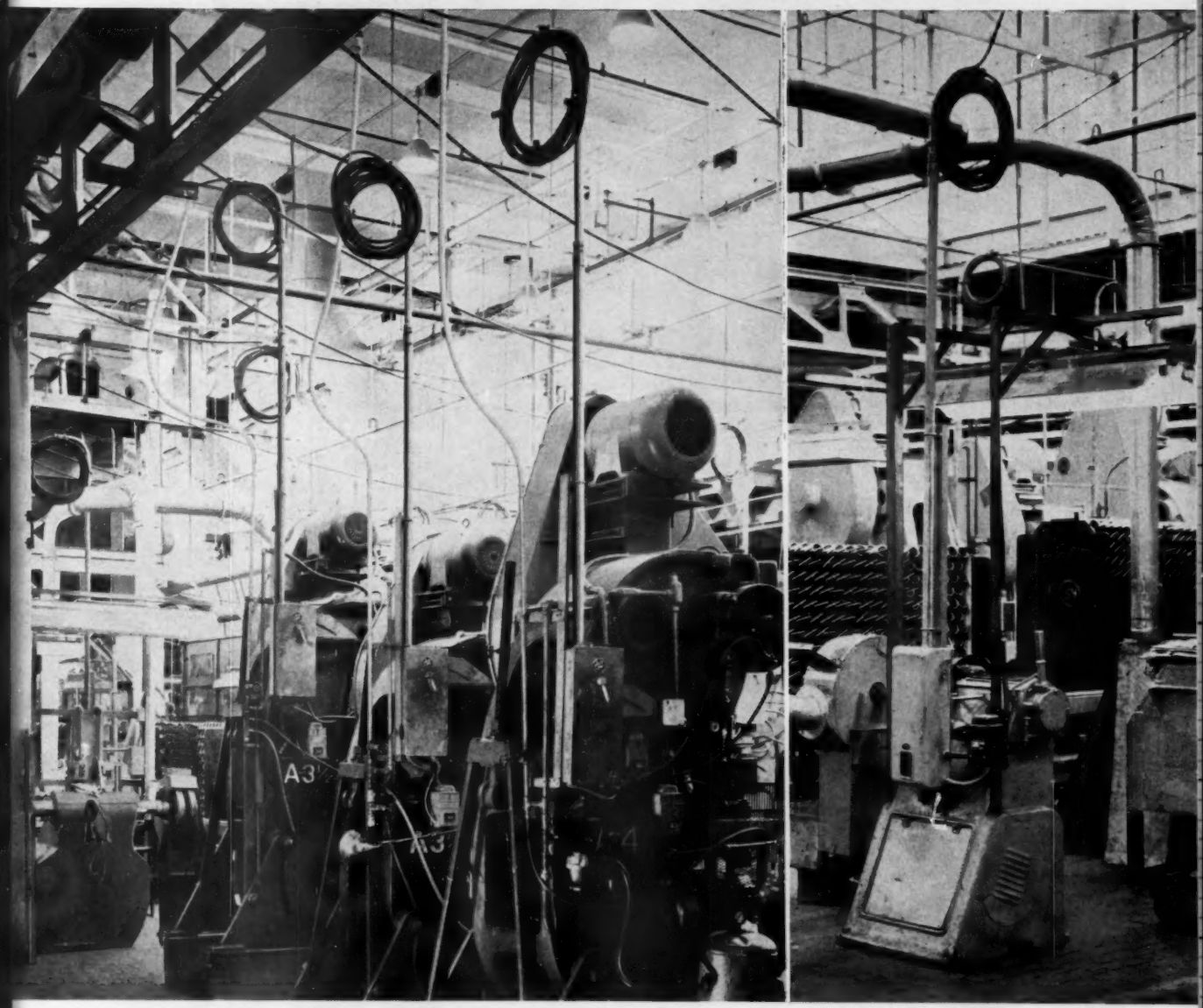
In an analysis of "Work Measurement and Standards", Edward Mann, industrial engineer for the Atlantic Refining Company in Philadelphia, mentioned that there is a common misunderstanding that work measurement and time studies are synonymous; whereas work measurement is really a management routine for determining total time required to perform a given task, while time studies are basically production analyses that break down total job times into productive and non-productive components. Productive time, he said, can be further divided into direct and indirect work, while non-productive time may be either avoidable or unavoidable.

"Training the Maintenance Force", as discussed by Frank Welch of the Carrier Corporation, Syracuse, N. Y., was also well received and, in his talk, he stated that "the training of maintenance personnel is one of the toughest jobs in industrial training, for the very nature of their work makes it difficult to schedule classes. Yet worthwhile training can be arranged if the need for it is properly sold to both labor and top management and, when this is done, results are definitely satisfactory. But maintenance training must be based upon needs," he continued, "for the time, effort and money spent on training merely for the sake of training is wasted. Clues as to need of training are frequently indicated by

**ELECTRICAL ENGINEERS** G. A. Runstrom and E. J. Payne of Western Electric Co., Chicago, view time-saving method of cutting large cables and conduit. Tome Sowin, Porter-Cable Co., Syracuse, N. Y., demonstrates use of portable band-saw at Plant Maintenance Show in Chicago.

**MAINTENANCE ELECTRICIAN** Carl Heeg and William Cooney, chief of plant maintenance at Weil-McLain Co., Michigan City, Ind., watch C. W. Plumer, The E. H. Wachs Co., Chicago, demonstrate a portable guillotine hack saw at the Plant Maintenance Show in Chicago. Unit, which can be strapped to installed pipe or conduit, is powered by an electric drill motor.

**FUNGAS ATTACK** on cable insulations is subject of this Plant Maintenance Show conference between: (L to R) E. J. MacKenzie, Simplex Wire & Cable Co., Cambridge, Mass.; H. C. Van Smith, general foreman of electrical maintenance at Standard Oil Company's Sugar Creek, Mo., refinery; and Peter Reiner of the Simplex Company.



**Coils of Anaconda Powerduct cable** (near ceiling) provide reserve footage for simple relocation of machines. This system greatly increases advantage of busduct, saving time and cost of moving rigid conduit.

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**SELF-DRILLING** expansion shells for masonry construction interest electrical contractors at Plant Maintenance Show in Chicago. Watching installation of shells with an electric hammer are: (L to R) Ken Lint, Lint Sales, Inc., Chicago; Alfred Grafer, Skokie Valley Electric Co., Skokie, Ill.; David Rosenstein, Spar Electric Co., Chicago; Dennis Mader, Amber Electric Co., Chicago, and demonstrator Dick Swon of the J. D. Polis Mfg. Co., Chicago.

lack of basic techniques, operational delays or breakdowns, unreasonably high work costs, operations having high accident rates, or fields where design changes and technological advances are rapid, such as in the fields of electronic controls. In setting up a training program," Welch concluded, "management should decide who should be trained, what subjects should be covered, where should the training be done, what methods should be used, who should instruct, when should classes be scheduled, what results are to be sought, and who will pay for the training."

In all of the general sessions and planned discussions, questions from delegates in attendance were numerous and searching in scope, yet some of the most practical interchanges of ideas were developed in the 16 roundtable meetings held the evenings of the second and third days. Subjects including the maintenance of electronic control equipment, electrical distribution equipment and lighting systems, storekeeping and inventories, use of punched card systems, use and development of safety manuals, and safety protection were all well attended, and it was in these sessions that chairmen and delegates really got down to the "nuts and bolts" level of maintenance problems. These roundtables were informal, practical bull-sessions, where problems of an individual plant or maintenance group could be reduced to basic essentials, then reconstructed into practical, useful methods.

## Building Trades Hold Wage Line in Chicago

Contractors in the Chicago area are hopefully anticipating a measure of cost stabilization in the construction field. Basis for their optimism is the announcement that Chicago building trade unions have decided to hold the wage line this year. For the first time in the past 12 consecutive years, no wage increases are being asked by 13 major AFL construction crafts. The decision to "skip" this year stems from a "gentlemen's understanding" reached by officials of these unions representing more than 102,000 members.

Apparently they feel that wages are as high as can be justified and that an increase at this time would adversely affect the work volume the industry is now enjoying.

Crafts participating in the agreement include the electricians, carpenters, bricklayers, plasterers, painters, plumbers, steam-fitters, lathers, sheet metal workers, laborers, cement masons, boiler makers and hoisting engineers.

There is, however, one "out" in the agreement. If two of the five "basic" crafts (carpenters, bricklayers, painters, electricians and pipe trades) negotiate a pay raise this year, the other unions can demand one also. At present there is no evidence that any of these crafts will violate the "understanding." Should this occur, the Building Construction Employers Association undoubtedly would resist demands for higher hourly rates or additional fringe benefits at the present time.

**INDUSTRIAL LIGHTING** was the conversation topic of: (L to R) George Ross, Sylvania Electric Products, Inc.; A. J. Rubin, plant engineer and C. J. Cookson, in charge of electrical maintenance at Carter Carburetor Corp., St. Louis, Mo. Engineers inspected Sylvania's newest units at Plant Maintenance Show in Chicago.


Introduced only a few weeks ago, Triangle E. M. T. with the new "Silver" inside finish has already won the acclaim of hundreds of contractors, engineers, electricians and maintenance men. Those who have seen or tried this new E. M. T. are specifying it. Already, many orders are marked: "E. M. T. with new 'Silver' inside finish."

This new "Silver" finish on the *inside* of all Triangle E. M. T. makes a hard, smooth, clean raceway—a raceway that not only makes wire-pulling much easier but gives unprecedented protection against the ravages of moisture, chemicals, oils, greases and fumes.

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**MEN RESPONSIBLE** for design and installation of electronically controlled, electric glass panel heating in ceiling and unit ventilator of new co-ordinated classroom at Grant Community High School in Fox Lake, Ill., are (L to R) Jack Bowen, engineer, Minneapolis-Honeywell Regulator Co., Inc., Chicago; architect Nairne W. Fisher, Fisher-White & Associates, Chicago; Leon Appleman, president, Electriglas Corporation, Bergenfield, N. J.; Stanley C. Gray, Chicago manager, Minneapolis-Honeywell Regulator Co., Inc.; and Bernard C. Carney, engineer, The Trane Company, Chicago.

## Todd New President of Electrical Inspectors

Samuel R. Todd, Chicago, Ill., is the new international president of the International Association of Electrical Inspectors. He succeeds B. A. McDonald, Rochester, N. Y., whose term of office ended last December.

A specialist in communications and theatre wiring, Mr. Todd is a graduate electrical engineer (Armour Institute of Technology, 1913) and a registered professional engineer in Illinois. After receiving his degree, he served as an electrical inspector in the Chicago Bureau of Electrical Inspection. During World War I, he organized a company of communications experts for the U. S. Army Signal Corps and served with distinction in France. During World War II, he held the rank of Lieutenant Colonel and Colonel for three years as Signal Officer, Sixth Service Command (Ill., Wis., Mich. and Northern Ind.) responsible for communications. His Sixth Service Command plan for an air raid warning system was adopted without practical change for both the Fifth and Seventh Service Commands. In 1949, he was the sole representative of the United States to a 60-nation conference held at Geneva, Switzerland to develop a new "Electrical Safety Code" for factories and industrial plants in Europe.

SAMUEL R. TODD

With the City of Chicago Electrical Inspection Bureau, Mr. Todd's specialty is the inspection, electrical design, installation, maintenance and operational techniques in all types of theatres. In 1933 he prepared the first draft of the National Electrical Code Standards covering installation of sound equipment and accessory apparatus in motion picture theatres. These standards had already been in effect in 276 Chicago theatres. His detailed design for the "Modern Projection Room" is a recognized standard in many U. S. cities. He served as a consulting engineer for many theatres in the U. S., Canada and the United Kingdom; wrote the entire theatre sections of the 1939 and 1954 Chicago Electrical Codes and has presented a number of papers at the Society of Motion Picture and Television Engineers meetings. He has been a member of the Electrical Committee, NFPA for 16 years.

Mr. Todd's activities with the IAEI cover a wide span of years. He was chairman of the Illinois Chapter Meetings and Program Committee for 25 years; chairman of the Illinois Chapter (1933); president of the Western Section (1937); general chairman of the All-Section Silver Jubilee IAEI Convention (1953); international first vice president (1954). He is an Honorary Member of IAEI.

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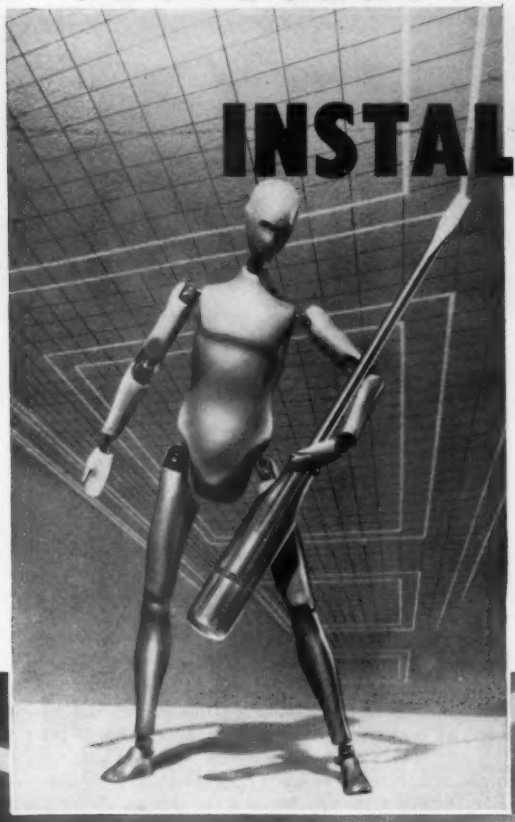

Only tool need is a screwdriver for final adjustment. No exact positioning required. Minimum number of parts and assembly on the job. Maximum simple adjustability at every critical point. Adaptable to most ceilings with a single, easy-to-install clip; provision for simple adaptability to all other ceilings. These new features save hours and dollars for you. And the Smithcraft Troffer installations you make mean more business for you. The new Smithcraft Troffer presents a clean, trim, uncluttered appearance because for the first time in the troffer lighting there are no visible catches, latches, bolts or screws. Perfectly straight, trim, in-line rows free from light leaks or blemishes. Here at last is a troffer that meets the contractor's every troffer need.

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**NEW DIRECTORS** of the Nebraska-Iowa Electrical Council, Inc., Omaha, Neb., include: (Front Row, L to R) C. P. Haas, General Electric Lamp Div. (mfgrs); L. F. Andrews, OK Electric Co. (contractors); Council President George Tice, Cutler-Hammer Co.; H. F. Graves, Fairbanks-Morse Co. (mfgrs.); Tony Schneider, Tele Radio Technicians (Television Electronics Service Association). In the back row (L to R) are: Don E. Rosenthal, Council managing director; Roger Critchett, D. M. Lucas Co. (distributors); R. H. Longmore, Omaha Electrical Works (contractors); Paul Donohue, Continental Can Co. (Electrical Maintenance Association); past-president of the Council, B. Stahmer, Industrial Electric Works; Charles Gendler, Best Appliance Co. (dealers); and Harold Soderlund Radio Station KFAB (broadcasters). Other directors not present in the photo are: Dan Kelly, General Electric Supply Co.; Dewey Baker, Omaha Public Power District; Bill Lohrman, Philips Dept. Store; William Baily, Wright & Wilhelmy Co.; C. L. Rhamey, Dundee Elecric Company (contractors); Tom Howell, Howell Furniture Company.

His active engineering society affiliations include the following: American Institute of Electrical Engineers, Institute of Radio Engineers, Western Society of Engineers, Illinois and National Societies of Professional Engineers, Society of Motion Picture and Television Engineers, Fellow of the American Association for the Advancement of Science. He holds life membership in the Armed Forces Communications Association and the Society of American Military Engineers.

## Illinois Inspectors Hold Silver Anniversary

The year 1955 will go down in the records as a memorable one for members of the Illinois Chapter, International Association of Electrical Inspectors. At their annual winter meeting in Chicago, they celebrated their 25th Anniversary with an excellent technical program, a record attendance and a Silver Jubilee Dinner. This year, also, one of their members, S. R. Todd, Chicago, became international president of IAEI, and one of his associates in the Chicago Electrical Inspection Bureau, J. J. Ryan, became Chapter chairman.

On the technical agenda, Leonard S. Inskip, protection engineer, Bell Telephone Laboratories, Murray Hill, N. J. (and chairman of N.E.C. Code Panel No. 5) presented a highly interesting and informative slide lecture on grounding techniques. During his discourse, he covered methods for clearing high and low voltage faults, grounding in rural areas and grounding of portable equipment. Mr. Inskip emphasized the importance of ground resistance values, the need for a common ground between raceways and neutral conductors to clear low voltage faults, and the advisability of grounding rural installations to private metallic water systems. Use of plastic water pipe is producing serious electrical grounding problems, he noted and cautioned inspectors to double-check this on rural systems. Grounding of portable appliances in the home is receiving considerable attention at present, he added. The one big problem is the "do-it-yourself" handyman, who may reverse 3-wire cord connections and cause additional hazard. Grounding of portables to a neutral wire is definitely not recommended.

**NEW CHAIRMAN** of the Illinois Chapter, IAEI, John J. Ryan (left) receives congratulations and gavel from retiring chairman Gordon Maltby of Evanston, Ill. Mr. Ryan, supervisor of electrical inspections for the City of Chicago, took office at the Chapter's Silver Anniversary convention in Chicago.

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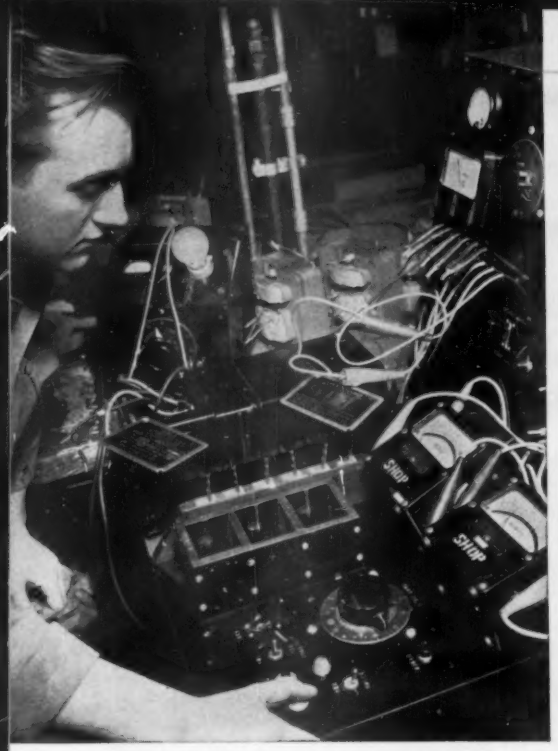
**RECOGNIZED AUTHORITY** on grounding, Leonard S. Inskip, protection engineer, Bell Laboratories, Murray Hill, N. J., gave members of the Illinois Chapter, IAEI, an informative short course on electrical system grounding techniques at their Silver Anniversary Convention in Chicago. Mr. Inskip is a proponent of common grounding between raceways and neutral conductors to clear low voltage faults or grounds.

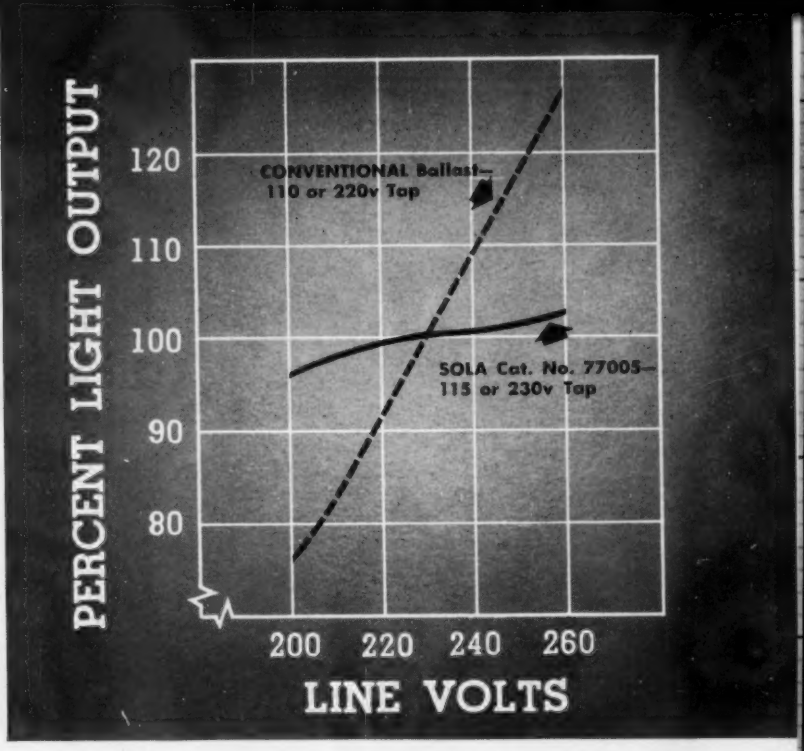
---

The present trend toward packing more horsepower into smaller motor frames may lead to hotter running motors and a need for inherent protection tailored to each motor, V. G. Vaughan, president, Versailles Products Co., Versailles, Ky., told the group. On the basis of five surveys made of motor repair shops, he revealed that 43.3% of their burned out motors had no inherent protection, 38.9% had the inherent protection device either removed or bypassed, and 8.4% of the burnouts had the inherent protection. Mr. Vaughan suggested a revision and simplification of N.E.C. Article 430, designation of maximum *ampere* ratings for motors by frame size instead of present Code Letter, and a requirement that all remote motor protective devices meet a common performance standard. This would lead to an ultimate simplification of N.E.C. Table 20, he concluded.

Article 700 of the 1953 N.E.C. now covers emergency power uses in addition to emergency lighting, H. H. Watson, commercial engineer, construction and materials division, General Electric Co., told the inspectors. However, the revised provisions are now intended only to tell how emergency systems and equipment are to be installed. The N.E.C. cannot require such installations to be made. That authority must come from a municipal, state, Federal or other code, or governmental agency having jurisdiction, he warned. He noted that some local ordinances may need revision to set up sound legal requirements for



**PRODUCTION LINE TESTING OF REGULATING ACTION:** Every Sola Constant Wattage Mercury Vapor Transformer is individually adjusted and tested to assure regulation of light output.




**LIGHT OUTPUT REGULATION COMPARISON:** The curves above compare the light output from an EH-1 mercury vapor lamp operating from a conventional non-regulating transformer against a Sola Constant Wattage Transformer under varying values of line voltage.

# Mercury vapor lamps operate at full rated light output with Sola Constant Wattage Transformers

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- Positive starting within the primary ranges of 100/200-130/260v without need for primary taps.
- Negligible starting line current surge, eliminating need for time-delay relays, oversize circuit breakers and oversize wiring.
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- Extended lamp life resulting from stabilized operation.

The moderate differential in original cost, over conventional non-regulating ballasts, is often eliminated by installation savings and by continuous high quality of performance you realize from your mercury vapor lighting installation. Write for the facts.

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**HAROLD A. WEBSTER,** president of T. Frederick Jackson, Inc., was recently elected chairman of the board of the Joint Industry Board of the Electrical Industry, New York City. He succeeds E. A. Kahn.

emergency system installations in public assemblage buildings. Probable length of time during which an emergency may exist is an important factor in determining the type of installation, Mr. Watson added. While Section 7004 of the N.E.C. requires an initial or acceptance test of the system, it is most important that periodic operating tests be made on automatic equipment in such systems, he cautioned.

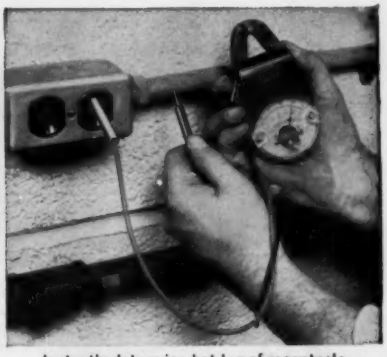
Electrical fires still top the list of known causes of fires. Most of these can be attributed to carelessness and failure to comply with standard rules of electrical safety, according to Charles L. Smith, field engineer, NFPA. He expressed deep concern about the "do-it-yourself" craze which tends to increase the installation of "permanent" wiring with flexible cords. Electric motors still top the list of fire causes with losses of fractional horsepower units showing a 5% increase last year, it was revealed. Subsequent discussion of this problem placed much of the blame on low voltage due to inadequate wiring capacity, particularly in washing machine motors. TV sets cause almost four times as many fires as radio sets, despite the fact that there are 10 times more radios in use, Smith noted. He asked electrical inspectors to help gather more fire-loss data by seeing that complete reports are filed with the Association offices.

Ray Ruddock, Chicago Automatic Switch Co., discussed the selection and application of automatic transfer switches to transfer electrical loads from normal to emergency power sources.

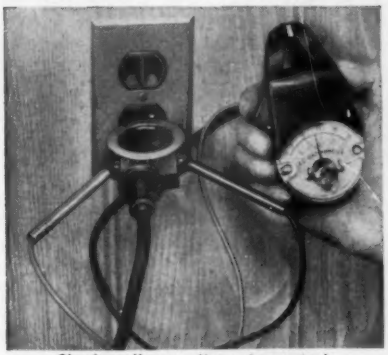
A plea for more members in IAEI, particularly more representatives of electrical contracting firms, was made by Vince Mulligan, Chairman, Western Section membership committee. He

Check appliance current at receptacle

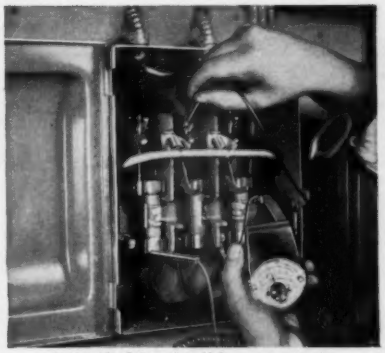
Trouble-shoot relays quickly



Instantly determine hot leg of receptacle



Check appliance voltage at receptacle



Instantly determine if fuses are good

Know if the load is balanced

Know if windings are grounded

Check capacity of motor capacitors

Expand low-amp reading by doubling lead

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**ARMORED CABLE** exhibit at Okonite Co. booth at Plant Maintenance Show in Chicago stops Walter L. Koons (center), electrical engineer of Johnson & Johnson, Chicago engineering firm and Harry Leith (right), electrical foreman, Inland Steel Co., East Chicago, Ind. George P. Cady, Okonite Co., explains application of steel, bronze and aluminum armored cables.

revealed that IAEI has set a goal of 2,500 new members in 1955. To start the ball rolling, the Illinois Chapter had a membership booth at its meeting.

At the final business session, John J. Ryan, supervisor of electrical inspections, Chicago Electrical Inspection Bureau, was elected chairman of the Illinois Chapter. Joseph Crosno, Bloomington, Ill., is first vice chairman; J. P. Corcoran, Chicago, second vice chairman; and Cal Condon, Flossmoor, Ill., third vice chairman. Clarence Wingfield, Chicago, was re-elected secretary-treasurer. Members of the New Executive Committee are: Don Coutts, Chicago, chairman; W. W. Kingsbury, Chicago (manufacturers); Henry Czech, Chicago (wholesalers); Joseph Turek, Berwyn, Ill. (contractors); and J. Gordon Maltby, Evanston, Ill., past-chairman.

**PLASTIC LOUVERS** for large area lighting draws attention of W. C. Johnson (center), electrical engineer, Skidmore, Owings & Merrill, Chicago architects, at Plant Maintenance Show. R. M. Francis and T. F. Jordan of Benjamin Electric Company point out features of the Benjamin units.

# Here's the team that will help you lower your Bid—

## *maintain your Profit!*

BECAUSE getting the job done faster, for less, is a big factor in meeting today's increasing competition, these time-and-labor-saving tools are vital to your contracting picture. Whatever the job, remodeling, modernizing, maintenance or repair, this Velocity Power team can help you keep your bid down, and still maintain your profit levels on every job.

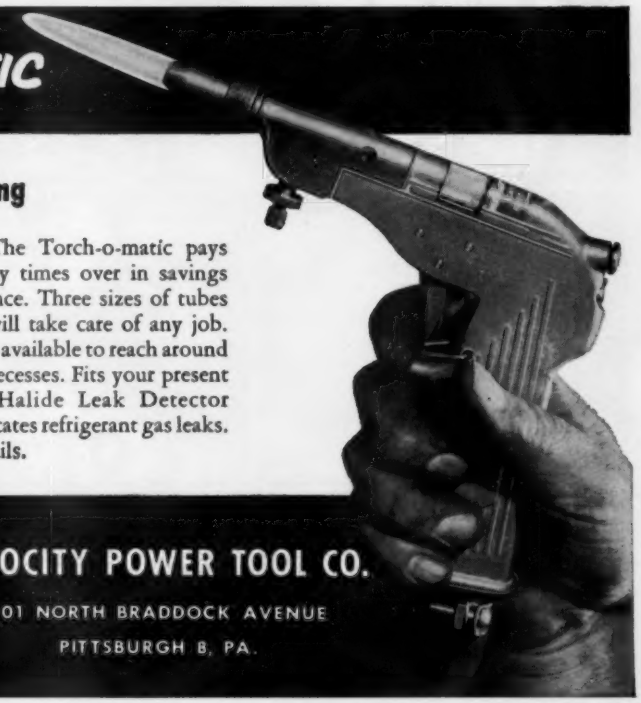
## THE VELOCITY-POWER DRIVER

### Drives Steel Studs into Steel, Concrete, Masonry in Seconds

Here's the tool that lets you finish off those anchoring and fastening jobs simply, easily, instantly! Just load—position—fire! Stud's embedded, job's done! Interchangeable barrels permit driving either ¼ or ⅜-inch studs from same firing unit. You have a wide-range of studs available—solid head, internal or external threaded types. And because of the integral cartridge and stud, you have no matching or fitting—they're ready for use.

Look at these safety features. A spring-loaded safety arm that must be rotated 180 degrees and held before firing, prevents accidental discharge. Permanently mounted spall-shield adds to the safety value. All cartridges are center-fire type, completely assembled, and color tipped to assure the right load for the job. Unique barrel design avoids ricochet, flash, recoil. Write today for details on this important aid for production and maintenance jobs.

## TORCH-O-MATIC



### For Faster, Easier Soldering, Brazing, Melting

This fully-automatic on-off air-acetylene gas torch gives you instant, one-hand operation, saves you time and gas, and eliminates open-flame hazards when not in use. Just pull the trigger and the air-acetylene gas lights instantly, ready for the job. Release the trigger and it's out! It's as simple as that, and remember, no "time-out" to light up and adjust. The Torch-o-matic pays for itself many times over in savings and convenience. Three sizes of tubes and nozzles will take care of any job. Extension tips available to reach around corners, into recesses. Fits your present equipment. Halide Leak Detector attachment locates refrigerant gas leaks. Write for details.

**IF YOU USE PROPANE...**

**Torch-o-matic is also available for use with propane gas. This Torch features trigger-control that ignites flame, extends flame from pin-point to a full 6 inches, and shuts flame off when trigger is released. You save time, gas, increase safety. Unit connects to tank—no intermediate valve fittings. Write for details.**

**VELOCITY POWER TOOL CO.**

201 NORTH BRADDOCK AVENUE

PITTSBURGH 8, PA.

## NISA Conference Held in Baltimore

The National Industrial Service Association held its annual Eastern Regional Conference on January 29 in Baltimore, Maryland. Eleven Baltimore motor repair shops, all non-chapter independent members of NISA, were hosts to the four NISA Chapters of the Eastern Region—New England, New York Metropolitan, Quaker City, and Electric Motor Service Association (District of Columbia)—and to other non-chapter members from the entire Northeast. The Conference was a busy one-day affair, with nearly 100 members and guests registered. Visitors from outside the Eastern Region included NISA's national president G. E. Jones, of Amarillo, Texas, R. E. Ward, Electric Motor & Repair Co., Raleigh, N. C., a contingent of members from Richmond, Va., and members of NISA's headquarters office in St. Louis.

Chairman of the opening session was Charles K. "Ken" Gibbs, Industrial Electric Co., Baltimore, who welcomed the visitors on behalf of the Baltimore repair shop hosts. He then introduced G. E. Jones, NISA President, and Joseph H. Previty, Penn Electric Motor Co., Philadelphia, NISA Vice President, each of whom addressed the group briefly.

The first feature address was made by Samuel Heller, President, American Rectifier Corp., New York City, who spoke on "Rectifier Applications—Their Selection and Maintenance". Mr. Heller described several key installations of selenium rectifiers which have been made recently, telling of the problems which were faced, what was selected and sold, and how it solved the problems involved. Here is a market that is a natural for motor repair service organizations, Mr. Heller said, and then told how to go about selling this market, what type and size rectifiers to use, and gave other similar and interesting information.

A local Baltimorean, James Taylor of Keystone Electric Co., Inc., gave a slide-illustrated talk on "Conversion of Sleeve Bearing Motors to Anti-Friction Operation". Slides covered both line drawings with cross-hatched sections showing new parts added during conversion, and photographs of various frame-type motors with "before" and "after" views of the same motors. In this field, also, Mr. Taylor pointed out the many opportunities available to motor repair shops to get this "plus" business more or less for the asking, and how to go about it, the amount of work involved, customer benefits, and other useful suggestions.

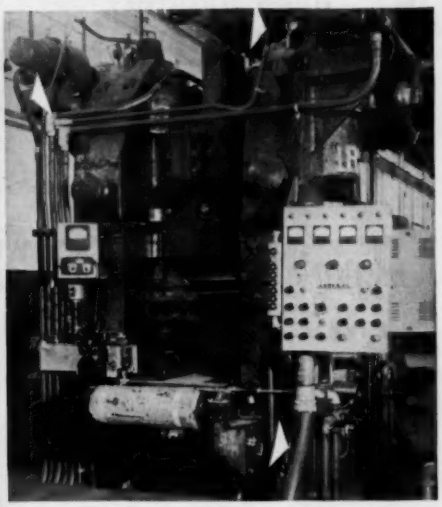
The third and last feature speaker

NEWS ABOUT...

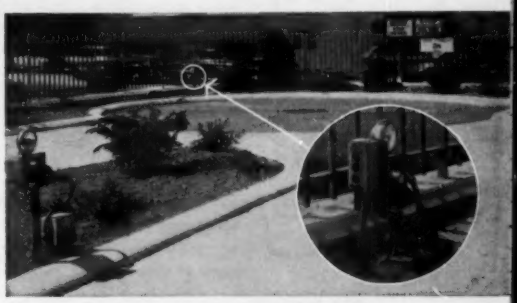
# SEALTITE flexible, liquid-tight electrical wiring conduit

**Used in a chemical plant, on a rolling mill and on electronic controls, easy-to-install SEALTITE—with tough PVC cover—again proves its versatility and economy.**

In a chemical plant, Sealtite . . . **RESISTS WATER, ALKALI, HEAT.** According to Ed Cieckiewicz, Plant Superintendent, Diamond Alkali Co., Jersey City, N. J., this 28″ length of 1¼″ SEALTITE* Electrical Wiring Conduit is holding up very well under conditions which caused another conduit to fail rapidly. Temperatures in this furnace department room run as high as 150°. The previous conduit dried and cracked in a short time and water was able to seep in and short the wiring. Alkali dust is also a constant threat. But when SEALTITE was installed these troubles ended. SEALTITE's tough vinyl cover protects wiring against oil, grease, water, dirt, chemicals, corrosive fumes and salt spray.



On a rolling mill, Sealtite . . . **CONNECTS MISALIGNED OUTLETS AND ABSORBS VIBRATION.** Wiring on this rolling mill—installed in a steel plant by Harlan Electric New York Corp., Buffalo, N. Y.—was run in SEALTITE Flexible Electrical Wiring Conduit wherever offset installations had to be made and wherever there was operating vibration. (See 4″ SEALTITE in lower right hand corner and 1″ and 1½″ SEALTITE in upper left and center of photo.) SEALTITE is perfect for this use because it can be cut on the job, is easy to handle, easy to attach to liquid-tight connectors and easy to flex. When vibration is present, SEALTITE's flexibility helps prevent damage to the conduit and the wiring it encloses.



On outdoor electronic controls, Sealtite . . . **PROTECTS VITAL WIRING AGAINST WEATHER.** Because of space limitations, The Citizens & Manufacturers National Bank of Waterbury, Conn., had to build two driveways and install a steel turntable in order to set up a drive-in window. The turntable—which swings the car around in a 120-deg. turn—is electronically controlled by means of several light beams. All wiring to the electronic controls and switches is protected by SEALTITE Flexible Electrical Wiring Conduit. SEALTITE was chosen because its tough PVC cover stands up under heat, cold, rain and snow, and can be buried underground. SEALTITE requires no cumbersome tools, no special skill.

*Trademark †Pat. Applied For

84178

**FREE BOOKLET!** Write today for your free copy of Bulletin UA-530, describing SEALTITE Types U.A. and E.F. and their applications. The American Brass Co., American Metal Hose Branch, Waterbury 20, Conn.

**SEALTITE**

**AVAILABLE IN TWO TYPES**

**TYPE U.A.** — First flexible conduit to be approved by Underwriters' Laboratories, Inc.

**TYPE E.F.†** (Extra Flexible)—meets standards set by J.I.C. Now available in machine tool standard light gray #257 from mill stocks.

**flexible, liquid-tight electrical conduit— an ANACONDA® product**

**INSPECTING** new ladder-type cable trough are: (L to R) Joel Johnson, mechanical engineer and Sam Cooper, electrical engineer, Detroit Transmission Div., General Motors Corp., Ypsilanti, Mich. Latest addition to cable-trough family features sections for ducking over and under obstructions, has protective covers and was shown at the Globe Company (Chicago) booth at Plant Maintenance Show in Chicago.

on the morning session program was Ralph O. Kufan of Hatboro, Pa., who told the members "How to Calculate Your Own Stator Windings", and the many benefits this knowledge provides. Mr. Kufan used a chalk-board to present typical formulas and solutions of some typical examples. Knowledge of how to calculate windings comes in handy, he said, when the data on a particular motor becomes lost, or for changing the rating of a motor, for determining the quality of a particular motor, etc.

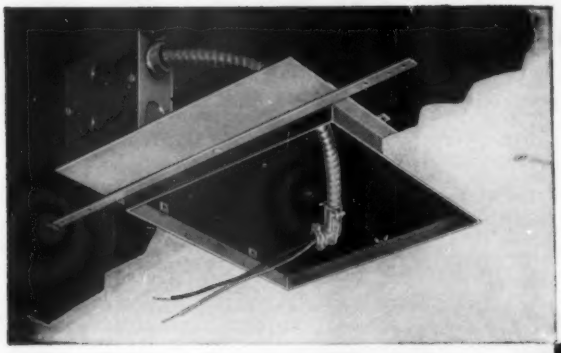
The afternoon program consisted of parallel activities to meet the different desires of the guests. One group visited the Riverside steam electric generating station of the local electrical utility company, the Consolidated Gas Electric Light & Power Company of Baltimore. Another group visited some of the local motor repair shops. A third group participated in an informal round table discussion, chairmanned by "Ken" Gibbs, and by Meyer Friedkin of Enterprise Electric Co., New York City. Many questions during this discussion period were directed to the speakers on the morning session program. Other questions related to shop techniques, materials, etc., and to an interchange of ideas and practices on the operation and management of motor repair shops and services.

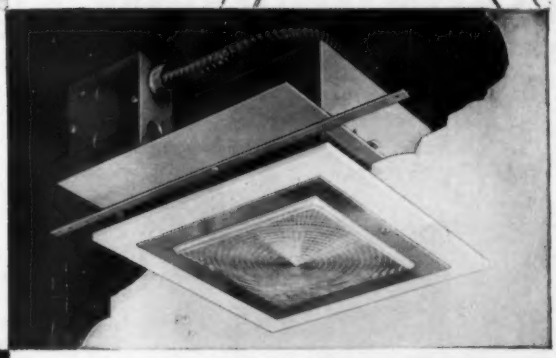
This busy Conference concluded with a cocktail party and dinner-dance. "Ken" Gibbs was toastmaster following the banquet, during which time the officers, commitee chairmen, visiting dignitaries and others were introduced.

# ART METAL

## makes your wiring

## EASIER *and* FASTER





The Binary Plaster Frame of Art Metal units has complete installation equipment including attached junction box, wire, Greenfield and two mounting rails.

Complete specifications on Art Metal pre-wired plaster frame and lens boxes are found in Bulletin 254. We suggest you write for this bulletin . . . it'll show you how to save installation time and money on your next job!

Art Metal recessed lens box housings are easily installed as the job nears completion. Vertical slotted mounting holes provide adjustment for ceiling thickness from ½" to 2".

THE **ART METAL** COMPANY

CLEVELAND 3, OHIO

**THE INSIDE STORY** on switches, sockets and trouble lights is given by Field Crosby, McGill Mfg. Co., to electrical engineers Arthur Koehler (center) and G. J. John (right) of the International Harvester Co., Chicago, at the Plant Maintenance Show.

Vice President Joe Previty lauded the Baltimore members for their sponsorship of this Regional meeting, and expressed the hope that the Baltimoreans would form a NISA Chapter of their own as soon as possible.

Baltimoreans serving on the Conference Committee included: Bernard Lipman, chairman, Lipman Electric Co., Inc; Charles K. "Ken" Gibbs, Industrial Electric Co; William A. Hoke, Keystone Electric Co; and John R. Lange, Lange Electric Co., Inc. Other Baltimoreans taking part as sponsors of the Conference were: Libby Bichell, The Electric Motor Repair Co; A. J. Morris, General Electric Equipment Co; Joseph Hanle, Hanle Electric Co; Ray E. Herr, Herr Electric Co; Raymond O'Brien, William C. O'Brien Co; Roland Stolzenbach, Roland Electrical Co; and Charles Stark, Stark Electric Co.

## AIEE in N. Y. for Winter Meeting

The 1955 Winter General Meeting of the American Institute of Electrical Engineers was held at the Hotel Statler, New York City, from Jan. 31 to Feb. 4. A wide range of subjects covering progress and development in electrical engineering were discussed during the 5-day meeting which was attended by over 4600 members and guests.

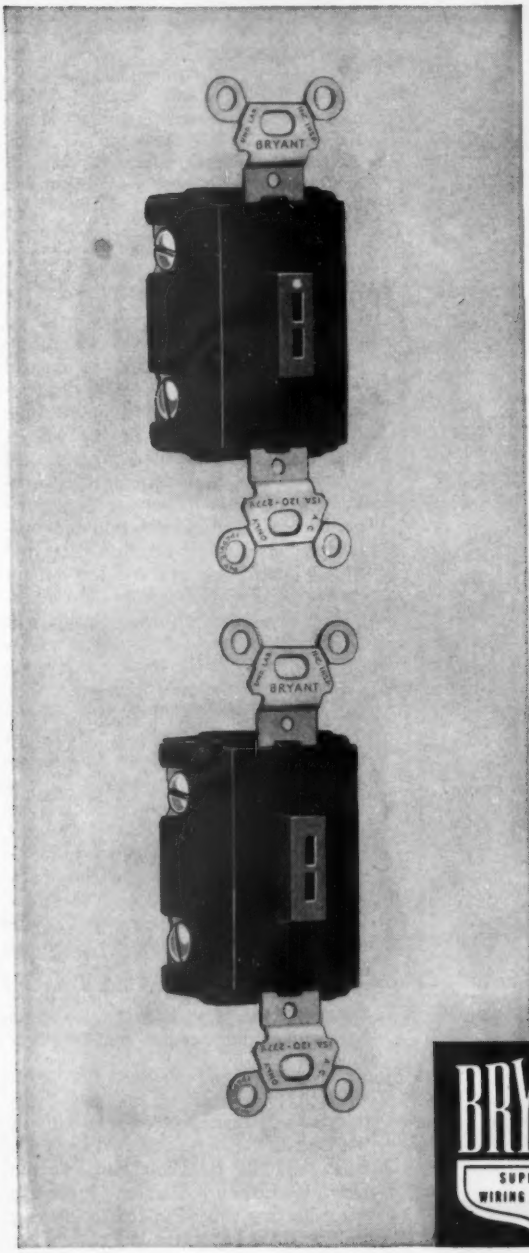
During the meeting, M. D. Hooven, Public Service Electric and Gas Company, Newark, N. J., was nominated as the 1955-56 president of the Institute.

At the opening general session of the meeting, Brig. Gen. David Sarnoff, chairman of the board of RCA, was

# Bryant Announces new

# LOCK-TYPE SWITCHES

## FOR 4801 (15 AMP) AND 4901 (20 AMP) A.C. SWITCH LINES




Latest additions to the popular new 4801 and 4901 switch lines are these top-quality lock-type switches rated at 15 Amperes and 20 Amperes at 277 volts respectively. Available in single and double pole, three and four way.

### Rugged Construction, Heavy-Duty Service

Built to last indefinitely, these new lock-type switches will stand up under the toughest operating conditions in commercial and industrial use. They can be used to full rated capacity on fluorescent and tungsten filament lamp loads and up to 80% of switch rating for motor control, which means fewer switches, lower job costs.

### Quality Features

The new Bryant Lock-Type switches feature all of the outstanding quality characteristics of the 4801 and 4901 lines, including easy back wiring, silver contacts and quiet operation.

Listed by Underwriters' Laboratories, Inc. Meet all specifications.

**THE BRYANT ELECTRIC COMPANY**

**BRIDGEPORT 2, CONNECTICUT**

**Chicago • Los Angeles**

BRYANT
SUPERIOR WIRING DEVICES

J-99930

**CONTRACTORS** T. L. Hankins (Left), Condo Electric Co., Chicago, and Thomas J. Wigdahl, Wigdahl Electric Co., Chicago, inspect supplementary circuit breaker enclosure developed by Wigdahl to fit gang-meter centers in apartment houses. Unit has four 15-ampere breakers to serve additional circuits for apartment rewiring.

the guest speaker. He discussed several new electronic developments of broad significance—an electronic sound synthesizing device that can duplicate exactly any sound, including musical sound and voice; an electronic ice-making device; a recording machine for storing television programs. At this session, Alexander Monteith of Westinghouse, president of the Institute, reported on plans for future organization of an association of engineers. The John Scott Medal and $1,000 award, one of the oldest honors in engineering and science, were presented to Marvin Camras, physicist at Armour Research Foundation, Chicago, in recognition of important inventions in magnetic recording. Other awards made during the 5-day meeting included: the John Fritz Medal to Harry A. Winne, retired vice president of General Electric Co.; and the Edison Medal to Oliver T. Buckley, retired president of Bell Telephone Labs. Most of the technical committees and sub-committees of the Institute, which has a world-wide membership of 50,000, participated in the program which included 93 technical sessions and symposiums on a wide range of electrical engineering topics.

Among the important developments reported at the meeting were the following:

• ELECTRIC HEAT using radiant panels has grown slowly but steadily in the Detroit area. As reported by A. E. Bush and R. P. Woodward of the Detroit Edison Company, electric space heating is used in 135 residences, 167 dwelling units in 17 apartment

*On all wiring in the $15,000,000 Beverly Hilton Hotel . . .*

REG. U.S. PAT. OFF. REG. U.S. PAT. OFF.

# SCOTCH BRAND HLOK Connectors and SCOTCH BRAND Plastic Tape used exclusively!

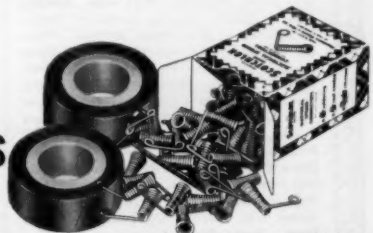
**DESIGNED** by Welton Beckett, F.A.I.A., & Associates, the multi-million-dollar Beverly Hilton Hotel is now under construction in Los Angeles, California.

When C. D. Draucker, Inc., installed the wiring at the new 450-room Beverly Hilton Hotel in California, they wanted nothing but the best in materials. That's why they made all splices with "SCOTCHLOK" Brand Electrical Spring Connectors and "SCOTCH" Brand Plastic Electrical Tape.

"SCOTCHLOK" is the world's tightest-gripping wire connector. Just twist on, snap off winding stem and the splice is made! Steel-spring construction never shakes loose.

"SCOTCH" Brand Plastic Tapes are backed by a polyvinyl chloride film which resists sunlight, moisture, alkalies, oil and acids. The backing also provides excellent dielectric strength and abrasion resistance. All "SCOTCH" Plastic Tapes conform well to most surfaces . . . and a little tape goes a long, long way.

*Other* "SCOTCH" *Brand Electrical Products are Glass Cloth Tape No. 27,* "SCOTCHFIL" *Insulating Putty and* "SCOTCHKOTE" *Electrical Coating.*



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**SCOTCH** BRAND **Electrical Insulating Products**

The term "SCOTCH" and the plaid design are registered trademarks for the more than 300 pressure-sensitive adhesive tapes made in U.S.A. by Minnesota Mining and Mfg. Co., St. Paul 6, Minn.—also makers of "SCOTCH" Brand Magnetic Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. Export Sales Office: 99 Park Avenue, New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

**CODE PROBLEMS** receive prompt attention at the site of the new Sikorsky Aircraft plant in Stratford, Conn. Electrical inspector C. M. Godshalk (seated), who is also the architect's field representative on the job, irons things out with C. A. DiLallo, electrical supervisor for Fischbach and Moore.

buildings and two 12-room motels. They concluded that electric space heating at current rates costs about $275 a season for the average size home. This report was made as part of a session on electric space heating and heat pumps.

• MOTOR STANDARDS for future design of polyphase and single-phase squirrel-cage motors were discussed by F. W. Bauman, General Electric Co., Schenectady, N. Y., in a report titled "Comments on the NEMA Suggested Standards for Future Design of Integral Horsepower Induction Motors." He reported that G. E. engineers indicated that re-designing and re-rating are long over-due, to minimize variety of parts for greater manufacturing flexibility and better service to motor users.

• INDUSTRIAL LIGHTING "is a production tool in the hands of a human seeing machine, the efficiency of which is greatly influenced by the effectiveness of that tool," according to E. A. Clark, Humble Oil and Refining Company. He discussed light in the modern refinery process unit and said "Good lighting means greater P-E-M-S: production, efficiency, morale and safety." He offered flood-lighting as the best approach to lighting process operations, driveways and yards. He cited advantages of lower initial cost, lower maintenance cost and smooth, even light distribution which is superior to locally mounted fixtures. Mr. Clarke advocated light colored paint on structures and better lighting on walkways and in control rooms. He also stressed the importance of an emergency lighting system and of proper lighting maintenance.

• LIGHTNING PROTECTION was

**LIGHTING DESIGN** for the new Whitney Museum in New York City was planned by Thomas Smith Kelly (left), professional illuminating engineer, in cooperation with the architect, August Noel. The coordination of lighting and architecture was explained and demonstrated by Messrs. Kelly and Noel before the Residence Lighting Forum, New York Section, IES, at its November meeting held at the museum.

a subject discussed by C. L. Wagner, Westinghouse Electric Corp., at an industrial power systems symposium. He cited the rapid expansion of industrial plant electrical distribution systems as the factor which makes necessary proper plant protection against lightning and switching surges or ground faults. This protection is particularly important in continuous process industries such as chemical plants. In the past, surge protection was designed primarily to prevent damage to equipment itself. Today, however, loss of production due to equipment breakdown is a far more important reason for providing proper surge protection. Mr. Wagner said that surge protection must provide for switching surges as well as lightning surges. This means proper grounding to prevent switching surges or transient overvoltages due to arcing grounds. Lightning protection consists of adequate shielding to prevent direct strokes to the system and the use of lightning arresters and surge capacitors.

• MOISTURE DETECTOR for measuring moisture in oil used as a dielectric was described by M. F. Beavers, E. J. Shimanski and E. F. Timpane—all of General Electric Company. The instrument was developed primarily for use in transformer installations. It can be connected to supply lines to permit periodic check on moisture or used as part of a signalling device to warn of excessive moisture in oil.

Questions from the floor added materially to the discussions.

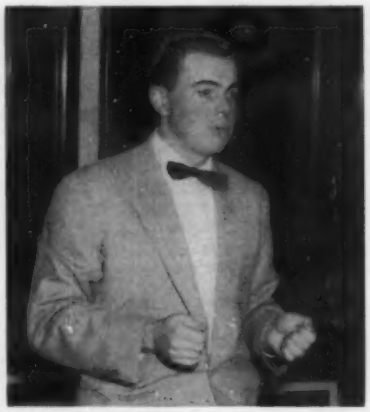
# IES Holds Office Lighting Clinic

The New York Section of the Illuminating Engineering Society recently held in New York City an all-day clinic on office lighting. Patterned after a school lighting clinic held early in 1954, and similar sessions being held in other parts of the country in recent months, it proved to be interesting, highly informative, and thought-inspiring. It was attended by over 100 lighting men, consulting engineers, office managers, architects and others involved or interested in office lighting progress.

This clinic consisted of ten talks and a question-and-answer session. Each talk was on a separate phase of office lighting, and was made by an authority on the subject involved. Henry L. Logan, vice president in charge of research for the Holophane Company, Inc. was moderator, and all speakers took part in the discussion during the question period.

The session was opened by L. R. Anderson, chairman of the New York Section of the IES, and engineer with the Lamp Division, General Electric Co., New York City. After outlining the purpose of the clinic, he introduced Mr. Logan as moderator and as first speaker, whose subject was "Why We Need Good Seeing Conditions in Offices". Mr. Logan explained that the reasons were the same as for needing good light in any place where seeing is involved, and described how man's nervous system has been developed through the ages around the sense of sight. He further discussed the influence of light on the physiological system, and the far reaching benefits inherent in good seeing conditions, in offices and elsewhere.

Next speaker was Douglas Haskell, editor of *Architectural Forum*, who discussed "Trends in Office Building Architecture". Current trends, he said, are to offices deeper in space, with interiors reaching far back from the new type curtain walls of porcelain enamel in color, or stone, marble, brick, etc. The trend is also to better environments, he said, to better acoustical treatment, better carpeting, air conditioning with quiet diffusers, better color treatment of interiors and away from the coldness of monotone interiors, and to use of removable ceiling panels for greater flexibility in lighting and acoustical treatment. He also reported that trends are now to higher standards for electrical distribution systems, including higher voltages for electrical distribution systems, and to new glass wall treatments. In multi-story buildings windows will probably be shorter and used for vision only, Mr. Haskell said, while in low buildings the trend is toward new uses of glass and new architectural treatments involving glass, plastics, colored enamel sheathing, etc. In commenting on lighting he said people like lighting troffers which are recessed flush in the ceiling, but that such systems are usually glaring. He also reported that luminous ceilings are still full of problems, that the plastics discolor in use and are hard to maintain, but said that even so they have a tremendous appeal to architects.



**LIGHTING SPECIALIST** Robert Burnham, F. W. Wakefield Brass Company, Vermilion, Ohio, outlines the need for uniform brightness and elimination of sharp contrast in modern school lighting. Burnham addressed panel workshop on new co-ordinated classroom at Grant Community High School, Fox Lake, Ill. New room has "Beta" Geometric, rapid-start fluorescent fixtures.

Murray L. Quin, product engineer for DayBrite Lighting Inc. next spoke on "Ceiling Construction and Recessed Lighting Equipment". Using a cleverly designed display showing cutaway sections of actual lighting equipment and ceiling panel sections, he demonstrated methods in use for recessing different types of lighting equipment in different types of ceiling construction. Eight such methods were demonstrated and each was discussed in detail. These included both permanently recessed systems, such as troffers in plastered ceilings, and the new flexible recessed systems, such as troffers or individual units which fit into T-bar or similar support frames which also support acoustical tile panels, and may be interchangeable when designed to the same modular dimensions.

"Factors for Good Seeing Conditions" were presented by W. S. Fisher, Lamp Department of the General Electric Co., Nela Park. This was an illustrated slide lecture, and covered some of the important psychological and physiological work of Dr. M. Luckiesch and his successor, Dr. S. K. Guth, research physicists for General Electric Company at Nela Park. This included lighting intensities, contrast, glare, brightness, and similar factors.

George J. Taylor, Eastern sales supervisor for DayBrite Lighting Inc. discussed "Interior Surrounds", and through the use of "props" specially constructed for this lecture illustrated some of the more important factors involved in office seeing problems, such as contrast, brightness, reflected glare, etc., including practical interpretation of the IES recommended values for some of these factors. He also discussed brightness ratios and their relative importance.

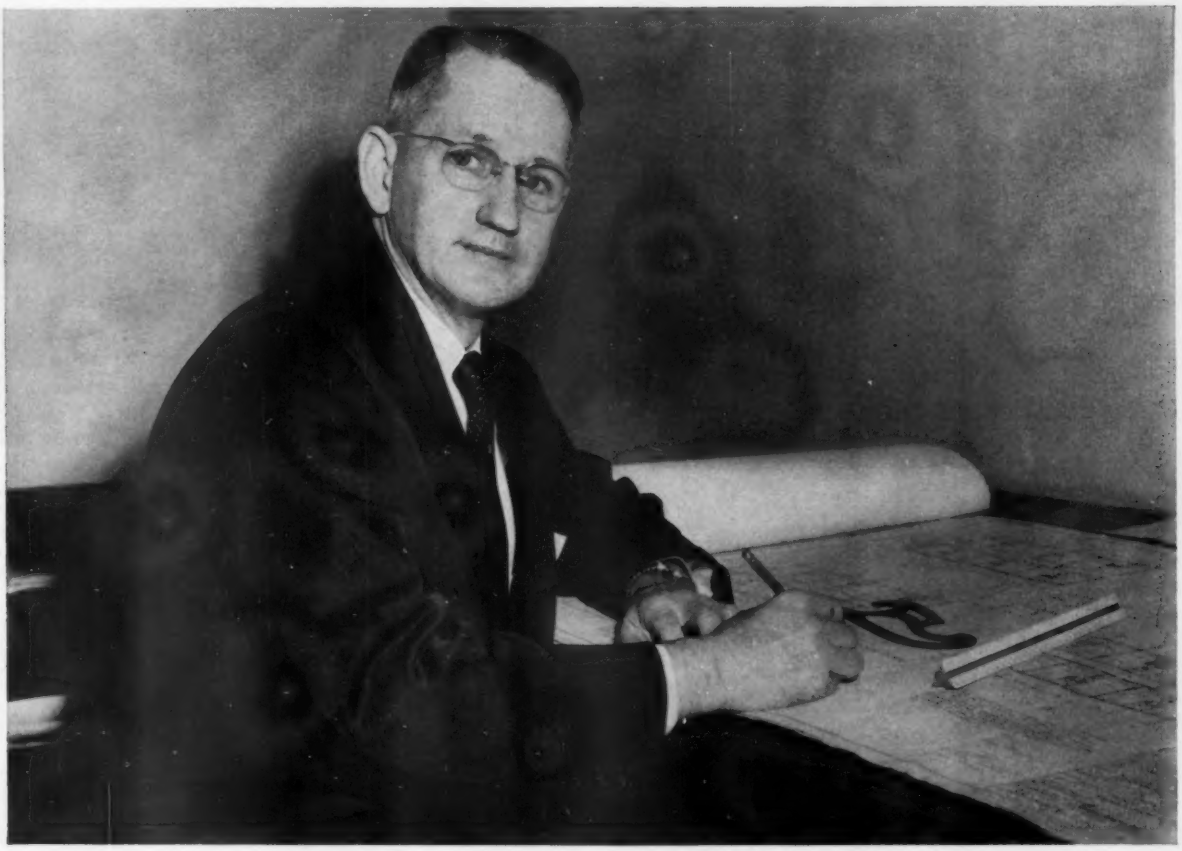
Howard D. Kurt, engineer with General Electric Co., Schenectady, N. Y. gave a very clear analysis of "Electrical Distribution Systems for Office Buildings", in which he compared design, equipment, costs, and advantages of the usual 208/120-volt Y-connected systems with those for the new high voltage system using 480/277 volts, Y-connected, which are being accepted and approved for use on some of the current larger office building installations now going in.

R. R. Wylie, lighting engineer with Sylvania Electric Products Inc. discussed "Lighting Maintenance", and outlined the relationship of adequate maintenance and its cost to initial lighting system design and the added cost which must be considered if the system is to be designed to provide ample illumination on the basis that it will not be adequately maintained after it is in service.

"Lighting Techniques for General Offices and Drafting Rooms" was presented by John J. Neidhart, lighting engineer with Westinghouse Electric Corporation, Cleveland Lighting Division. This talk was illustrated with slides, and covered the entire field of layout and design.

W. S. Fisher of General Electric Co., Nela Park, gave a presentation, his second for the day, on "Private Office and Miscellaneous Lighting". He also used lantern slides, and pointed out as they were shown the many good and bad features affecting the lighting in each example, involving a wide cross-section of lighting system techniques and methods.

The final talk was on "What Price Comfort", which was given by Henry L. Logan, moderator for the entire clinic session. Mr. Logan reviewed briefly comments made during the day on comfort in lighting, with particular emphasis on glare factors and methods of rating glare and comfort, and indicated that failure to consider comfort factors in lighting design can result in reduced production, eye fatigue and frayed nerves for employees.



Photograph of Mr. Henry F. Barksdale
Whitehead Electric Co., Atlanta, Georgia

# *"Lighting fixtures designed with the contractor in mind"*

Read what Mr. Barksdale says about Day-Brite fixtures:

*"For the past 12 years our company has installed Day-Brite fixtures throughout the state of Georgia and in the Southeastern area. Always, we have found that our final net profit on a Day-Brite job was most satisfactory. All in all, I'd say that Day-Brite fixtures are designed with the contractor in mind. The ease and speed with which we can install them means a lot when a completion date has to be met."*

**Mr. Barksdale is one of hundreds**

Mr. Barksdale is not alone. He is one of hundreds of electrical contractors throughout the United States who are sold on the through-and-through quality of Day-Brite fixtures, on their overall performance in providing the right light for the right job, on design features that save installation time.

**Details that count**

This time-saving Adjustable "A-J*" Hanger is just an instance of Day-Brite's attention to details that help the contractor. It is the easy, low-cost way to reduce installation time on hard-to-work-with, uneven ceilings. Swivel fitting and 1⅛" hand-operated vertical adjustment let you lay in your fixture run, trim it up later... No field assembly of screws, bolts or locknuts is required. "A-Js" give you a quick simple, foolproof way to save time, increase profit.

**Other Time-saving Day-Brite Fittings:**

Hydee** Hangers, Sliding Clamp Hanger Fittings, Twin-stem Hangers (8" and 24" lengths), Ice-Tong Hanger Clamps.

Day-Brite Lighting, Inc., 5402 Bulwer Ave. St. Louis 7, Mo.... In Canada, Amalgamated Electric Corp., Ltd., Toronto 6, Ont.

SEE YOUR DAY-BRITE DISTRIBUTOR

"DECIDEDLY BETTER"
DAY-BRITE®
*Lighting Fixtures*

*PATENT NO. 2446736. UNDERWRITERS APPROVED. TM REG. U.S. PAT. OFF.

**PATENT NO. D-141024 AND NO. 440814. UNDERWRITERS APPROVED. TM REG. U.S. PAT. OFF.

5426

**NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT**

**HEADING UP** the Engineering and Construction Division of Engle Electric Co., Lakeland, Fla. is Fred S. Shinn, who is also active in the organization of the Florida Association of Electrical Contractors. His Division does some industrial work, but is kept busy mostly with commercial jobs, both large and small.

## NISA News

Grand Rapids Armature Works, a NISA member, and Sanford Electric Co., both of Grand Rapids, Mich., merged Jan. 1 under the name "Consolidated Electric Co., Inc." Clark Mesler of Grand Rapids Armature is president of the new company, and Carl Sanford is secretary.

• • • •

Excel Electric Service Co., Chicago, has joined its two buildings at 2113 South Western Ave. with a basement and first floor addition, making 22,000 square feet total space for the firm.

• • • •

Like to go to Mexico City or Hawaii? From Los Angeles to Mexico City it is a pleasant hour flight, and easy to arrange.

Hawaii is reached by a pleasant airplane ride over the blue Pacific waters or on a relaxing Matson "Lurline" cruise of five days.

NISA Conventioneers interested in visiting either of these places before or after the Los Angeles event June 6-10 can make arrangements by writing Hemphill Travel Service, Inc., 727 W. 7th St., Los Angeles 17, Calif.

Their offices are only a block from the Statler where the Convention is to be held.

However, reservations should be made in advance when possible. Convention Chairman William M. Hogue advises members particularly to plan their Lurline cruises early as the ships are booked well in advance.

• • • •

The remodeling of Abilene Electric Co., Abilene, Tex., was the subject of a feature story in the city's Reporter-


SIGNALING EQUIPMENT?
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- we have it
When you need signaling or telephone equipment for a job, you can get everything you need from Auth; you don't have to shop around. And when you offer Auth equipment, your customer knows he is getting a top brand, installed in many of the finest projects in the country.
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Manufacturers of audible signals, push buttons, annunciators, transformers, telephones, mail boxes, and complete signaling systems for hospitals, housing, schools and industry.
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IN CASE OF FIRE
AUTH ELEC

News. A two-column picture of a 200-hp motor illustrated the article.

Quoting owner Ellis McMillin, the story refers to the shop's new superintendent, J. S. Morgan, and J. R. Woodard, foreman, as two of the firm's employees who "are qualified by long experience to do highly successful job with the aid of the most modern power equipment."

The Abilene firm serves 38 counties in which oil refineries, municipal plants, cotton gins, bakeries, laundries and pipe lines are its principal customers.

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Recent visitors to National Headquarters include Charles J. Covington, Dowzer Electric Machinery Works, Inc., Mt. Vernon, Ill.; John M. Young, Anderson Young Electric Co., Lubbock, Tex.; and Sam H. Browning, Cleveland Electric Co., Birmingham, Ala.

Don't forget to drop in.

National Headquarters is located in the recently modernized Paul Brown Bldg., one of the city's finest office buildings, in the heart of downtown, just 10 minutes from Union Station, and only a few blocks from the city routes of U. S. 40, 50 and 66.

• • • •

Looking ahead, National Electrical Manufacturers Association expects its members to increase shipments by 5% over 1954.

This would bring sales back to the all-time high level of 1953 with a possibility that a new high level will be established.

1954 shipments were $15.6 billion as NEMA predicted. This was 5% below the record '53 peak of $16.4 billion. This year NEMA expects all branches of the industry to gain except for generating, transmission and distribution equipment which is expected to drop 5% since that branch experienced heavy increases for several years.

NISA director Howard A. Lilly, Tampa Armature Works, Tampa, Fla., was recently elected vice-president of the Tampa Kiwanis Club for 1955.

• • • •

"A complete one-stop electric service station" is the description of the Tennessee Armature & Electric Co., Knoxville, which appeared in a recent article in the Knoxville News-Sentinel. Among the many repair services offered by the firm, the separate fractional motor repair department received special mention in the article.

• • • •

Repairs to the building occupied in Trenton, N. J., by S&M Electric Motor Repairs are completed, owner Paul Secrest reported.

**BACCUS ELECTRIC** employees on hand at office at lunch time posing for this photo in Sarasota, Fla. were (l. to r.): Hanson "Hank" Gay, Bobbie Gay Baccus (owner's daughter and secretary), William "Bill" Turner, Larry Williams, W. Porder Baccus (owner), Art Cappelle, and Dan Donahue, salesman from electrical wholesalers Raybro, Tampa, Fla. W. P. Baccus is a member of the Florida Association of Electrical Contractors, does commercial electrical construction work primarily.

The second floor of the structure was severely damaged last September. Operations of the shop, which occupies the ground floor, were not affected.

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A "NEW FRAME OF MIND" must be adopted this year, the New England Chapter told its members in a special bulletin, to meet the challenge of the new and smaller NEMA frame sizes. "Let the manufacturers pack the horsepower in smaller frames for new equipment, and we will keep ourselves abreast in putting new life into the motors in the existing equipment and replacement field," the bulletin read. The bulletin reminded members that repair shops are "Equally progressive with the manufacturers in keeping in line with the improvements and developments of wire insulation and insulating materials in general, always bearing in mind that quality of material comes before price in the repair shop."

The New England Chapter met January 13 for dinner and to hear William Fluhr, engineer of Cutler Hammer Co., speak on electric motor controls.

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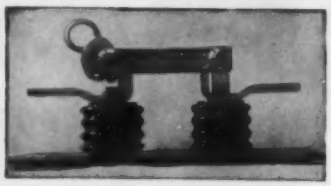
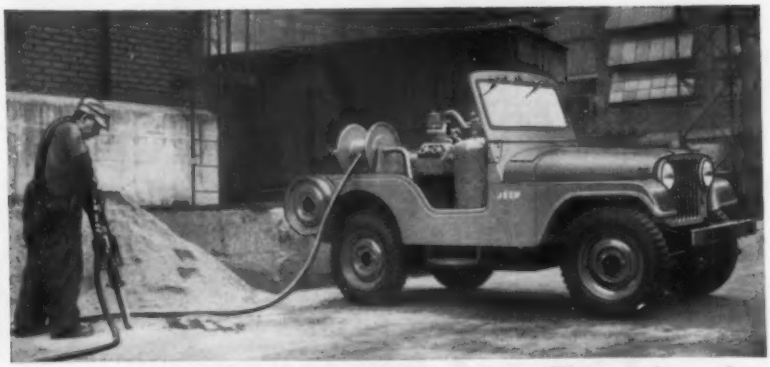
NISA's president, G. E. Jones, continued his travels in behalf of the Association with a January junket that found him in Detroit Jan. 17 for the testimonial dinner to Charles J. Cannon; in Milwaukee for a meeting of Wisconsin Chapter Jan. 18; in Buffalo Jan. 20 for the Niagara Chapter meeting; in St. Catharines, Ont. to talk











with members of Ontario Chapter Jan. 21; in Washington, D. C., Jan. 24; and in Baltimore for the Eastern Conference Jan. 29.

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Quaker City Chapter held its first meeting of the new year on January 12 at its regular meeting place, Beck's-on-the-Boulevard, Philadelphia. Because of the success of earlier informal discussions, the chapter scheduled a "round table night."

Chicago's NISA group, Central District Chapter, met January 11 at a new location, the Jade Room of the Graemere Hotel, for dinner and to hear Robert King, design engineer of Robbins & Myers Co., Springfield, Ohio, talk on "New NEMA Motor Frame Winding Technical Problems, Causes and Reasons behind Re-Rating."

The previous month Central District Chapter met at Chicago's Tower Club on December 12. New officers for 1955 were elected: president, Fred H. Westphal & Co., Janesville, Wis.; vice-president, Abe Marcus, Ther Electric & Machine Works, Chicago; secretary, Harold W. Reeve, Inland Industrial Electric Service Co., Chicago; treasurer, B. Ferrari Jr., Excel Electric Service Co., Chicago. Retiring president G. F. Glave, Chicago Electric Co., Chicago, introduced Fred Marshall of the Standard Electric Works, Chicago, a new member and Lee Butters who attended his first meeting as representative of A. Oppenheimer, Inc., Chicago.

• • • •

Greater St. Louis and King Coal Chapters held a joint meeting January 11, commencing at noon with a tour through the famous Anheuser-Busch St. Louis Brewery. At 4 p.m. the group arrived at Bevo Mill, for a business meeting and dinner.

At the business meeting, Mel H. Langford of Linde Air Products Co. discussed silicones and class H insulation, giving some interesting information on results acquired from tests made on motors having class H insulation. Major points of interest in his discussion were: increase in horsepower output, use of silicone grease for lubricating ball bearings of motors operating at high temperatures and effect on ball bearings of motors which have their horsepower output increased by using class H insulation. The latter part of the program was devoted to questions and answers.

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V. M. Nussbaum & Co., Fort Wayne, Ind., became Nussbaum Electric Co., Jan. 1.

*From Walter J. Prise, Queens Electric Motors, Inc., Jamaica, L. I., N. Y.*

**CAROLINIANS** talking over mutual electrical inspection problems at IAEI's Southern Section annual meeting in Tampa, Fla. were W. B. Stover, Duke Power Co., Charlotte, N. C., and Ben Sloan, Sr., chief electrical inspector of Greenville, S. C.

## DATES AHEAD

**9th Industrial Electrical Exposition**—Sponsored by Manufacturers Division of Essex Electrical League, Olympic Park, Newark, N. J., March 8-10.

**National Electrical Manufacturers Assn.**—Edgewater Beach Hotel, Chicago, Ill., March 13-18.

**Edison Electric Institute**—Sales Conference, Edgewater Beach Hotel, Chicago, Ill., March 28-31.

**Illuminating Engineering Society—Regional Conferences (1955): Southern**—Fort Harrison Hotel, Clearwater, Florida, March 31-April 1; **Southwestern**—Gunter Hotel, San Antonio, Texas, April 3-5; **Inter-Mountain**—Phoenix, Arizona, April 11-13; **South Pacific Coast**—Statler Hotel, Los Angeles, California, April 14-15; **Pacific Northwest**—Harrison Hot Spring Hotel, Harrison Lake, British Columbia (Canada), April 25-26; **Midwestern**—Edgewater Beach Hotel, Chicago, Illinois, May 2-3; **Canadian**—Mount Royal Hotel, Montreal, Quebec (Canada), May 12-13; **East Central**—Abraham Lincoln Hotel, Reading, Pennsylvania, May 19-20; and **Norhteastern**—Fort William Henry Hotel, Lake George, New York, June 10-11.

**Electrical Maintenance Conference**—University of So. Calif., Los Angeles, Calif., April 6-7.

**Chicago Electrical Industry Show**—Third biennial exhibit sponsored by the Electric Association of Chicago in cooperation with the Electrical Maintenance Engineers of Chicago, Conrad Hilton Hotel, Chicago, Ill., May 10-12.

**Pacific Coast Electrical Association, Inc.**—Annual convention, Palace Hotel, San Francisco, Calif., May 11-13.

**National Fire Protection Assn.**—59th annual convention, Netherland Plaza Hotel, Cincinnati, Ohio, May 16-20.

**National Association of Electrical Distributors**—47th annual convention, Conrad Hilton Hotel, Chicago, Ill., May 22-25.

[CONTINUED ON PAGE 230]

**National Industrial Service Assn., Inc.**—Annual convention, Hotel Statler, Los Angeles, Calif., June 5-9.

**Western Plant Maintenance Show**—Los Angeles, Calif., July 12-14.

**Edison Electric Institute**—Annual convention, Los Angeles, Calif., June 13-16.

**New York State Association of Electrical Contractors and Dealers, Inc.**—Annual convention, Saranac Inn, Saranac Inn, N. Y. June 27-July 1.

**Illuminating Engineering Society**—National Technical Conference, Statler Hotel, Cleveland, Ohio, September 12-16.

**International Association of Electrical Inspectors**—Western Section, annual convention, Hotel Nicollet, Minneapolis, Minn., September 26-28.

**Electrical Progress Show**—Convention Hall, Philadelphia, Pa., September 27-29.

**National Electronics Conference**—Hotel Sherman, Chicago, Ill., October 3-5.

**National Electrical Industries Show**—69th Regiment Armory, New York City, October 11-14.

**N. J. Council of Electrical Leagues**—19th convention, Atlantic City, N. J., October 14-15.

**National Electrical Contractors Association**—Annual convention, Waldorf-Astoria, New York City, October 31-November 4.

**Fifth Industrial Electric Exposition**—Hotel Wm. Penn, Pittsburgh, Pa., November 1-3.

**CERTIFICATE** for Fellow membership in the Illuminating Engineering Society was presented to Myrtle Fahsbender at the November meeting of the Residence Lighting Forum, New York, following her election to that grade on July 8 by the Board of Fellows. Miss Fahsbender is well known in the residence lighting field and is the only woman who has served as a director of the Society. She is Director of Residence Lighting for Westinghouse Electric Corporation. Making the presentation is Lou Goren, Vice Chairman, New York Section IES.

# Among the Manufacturers

## Headquarters Announcements

Solar Electric Corporation, Warren, Pa.—F. Leslie Watson, vice president in charge of sales.

United States Steel Corp., American Steel & Wire Div., Cleveland, Ohio—Norman M. Sted, assistant general manager of sales.

Swartwout Co., Cleveland, Ohio—Ernest H. Bellard, vice president in charge of sales.

Anderson Brass Works, Inc., Birmingham, Ala.—Lester R. Crane, sales manager of distribution equipment.

Opad Electric Co., New York, N. Y. —Henry L. Opad, president, reports that this new organization is producing all equipments formerly made by the recently dissolved firm of Opad-Green Co. Address is 69 Murray St.

Rawlplug Company, New York, N. Y.—Norman MacDonald, assistant sales manager.

Westinghouse Electric Corp., Pittsburgh, Pa.—John F. Myers, vice president; also general manager of consumer products.

Westinghouse Electric Supply Co., Pittsburgh, Pa.—Victor Kniss, president.

Moloney Electric Co., St. Louis, Mo. —David F. Winter, Director of Research.

Industrial TV Utilities Co., New York, N. Y.—Morris Salit, president.

Electri-Flex Co., Roselle, Ill.—H. W. Kinander, D. J. Lindholm and J. P. Doolin are principals of this new firm manufacturing flexible, liquid-tight conduit.

Federal Pacific Electric Co., Newark, N. J.—William M. Stark and Pierce G. Fredericks, commercial vice presidents.

Marvin Manufacturing Co. has opened a new factory-warehouse at 77-15 19th Rd., Jackson Heights, N. Y.

Jefferson Electric Co., Bellwood, Ill. —William J. Gorman, merchandising manager.

General Electric Co., Syracuse, N. Y. —Harold L. Blom, manager of marketing administration for communication equipment.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—B. G. Witty heads the new industry application section of the general machinery division. T. B. Montgomery will be chief engineer of this department.

Thor Power Tool Co., Aurora, Ill. —John B. Dempsey, manager of electric tool sales.

National Electric Products Corp., Pittsburgh, Pa.—Albert N. Semmel-

SEE PAGE 109



**CODE EXPERTS** at IAEI's annual meeting of the Southern Section, Tampa, Florida recently, were (l. to r.): Henry M. Dreher, NEMA, New York City; C. T. Jones, Southeastern Underwriters Assn., Atlanta; E. J. Dennis, inspector, Durham, N. C.; and C. M. Jones, Underwriters Lab., Inc., Chicago.

roth, manager of Torrance, Calif., plant.

Teleregister Corp., New York, N. Y. —Theodore M. Steele, assistant to the president. E. L. Schmidt, vice president in charge of industrial sales.

Empire Corporation, Milwaukee, Wis.—Gilbert M. Schucht, president and sales manager; George Thompson, Jr., secretary-treasurer and plant manager.

Standard Transformer Co., Warren, Ohio—Joseph S. Buchsbaum, general sales manager.

Thomas & Betts Co., Elizabeth, N. J. —Lee H. Bristol and J. Dugald White, directors.

### Regional Appointments

**NEW ENGLAND**

Mitchell Manufacturing Co.: Bertram E. Davidson, district sales manager of the commercial lighting division.

Delta-Star Electric Div., H. K. Porter Co., Inc.: James Kelso, Jr., field representative in Boston territory.

**MIDDLE ATLANTIC**

Graybar Electric Co.: W. J. Goerisch, assistant district manager in Philadelphia.

Marvin Manufacturing Co.: John Sankewich, district sales manager; Sid Klores, sales engineer.

Mitchell Manufacturing Co.: Burton L. Price, district sales manager for the commercial lighting division will cover Delaware, southeastern Pennsylvania, southern New Jersey and the Delmarva peninsula.

**SOUTH ATLANTIC**

General Controls Co. has relocated its regional sales office and warehouse to 1479 Spring St., N. W., Atlanta, Ga.

Micro Switch: Donald S. Schultz, manager of the new Charlotte, N. C., office.

Pittsburgh Standard Conduit Co.:

## SEARCHLIGHT SECTION

(Classified Advertising)

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WANTED ELECTRICAL Sales Engineer to travel Indiana, Ohio, Illinois, Southern Michigan. Make take-offs and handle bid follow-through on line of industrial and commercial electrical distribution equipment. Car, salary, bonus, expenses. Possible future sales management. Daly Equipment Co., 111 143rd St., Hammond, Ind.

AGGRESSIVE REPRESENTATIVE wanted by nationally known manufacturer of a complete line of Fluorescent and Slimline fixtures, including new type Plexi-glass bottom units. Deliveries prompt, and competitively priced, territories open in New England, New York, Pennsylvania, Illinois, Michigan, Texas, Florida, Louisiana, etc. RW-5289, Electrical Construction & Maintenance.

SALESMEN, WHO are now calling on electrical contractors, wanted by established manufacturer of fluorescent lighting. SW-5629, Electrical Construction & Maintenance.

### POSITION WANTED

ELECTRICAL SALESMAN electrical supervisor as estimator 25 years experience in electrical field send replies to PW-5548, Electrical Construction & Maintenance, 520 N. Michigan Ave., Chicago 11, Ill.

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ANYTHING within reason that is wanted in in the field served by Electrical Construction and Maintenance, can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.



Hopper & McCoy, Atlanta, Ga., are representatives for Georgia, eastern Tennessee, northern Alabama and the Florida peninsula.

**EAST CENTRAL**

Graybar Electric Co.: E. R. Yonkers, Cincinnati district manager; John Reine, assistant district manager at Chicago.

Electro Silv-A-King Corp.: Albert R. Warren, Pekin, Ill., district manager for central Illinois; H. P. Beard will hold the same position in the Arkansas, northern Mississippi and western Tennessee region.

Minneapolis-Honeywell Regulator Co.: Arnold Challman, administrative assistant to the manager of the Chicago regional office; R. C. Ferguson, manager of Peoria, Ill., office.

Allen-Bradley Co.: Robert L. Gove and Harold Mittelman, sales engineers at Detroit and Cincinnati offices.

Mathias Klein & Sons: Jack D. Bruce, sales representative.

Pittsburgh Standard Conduit Co.: E. J. Hagen, representative for Louisiana, Mississippi, and parts of Florida and Alabama.

**WEST CENTRAL**

Sterling Electric Motors, Inc.: Charles E. Cotham, Jr., district manager for Houston, Texas.

Graybar Electric Co.: M. A. Ellis-ton, Abilene, Texas branch manager.

Teleregister Corp.: Paul W. Larsen, district manager of new southwest district office at Houston, Texas.

General Controls Co.: A. E. Hess, southwest regional manager, offices in Dallas, Texas. W. K. Walters, regional manager of the Houston office.

Sylvania Electric Products Inc: William C. Lounsbury, Jr., sales manager for lighting products in the Kansas City district.

Minneapolis-Honeywell Regulator Co.: R. R. Scott, manager of Davenport, Iowa branch.

**WEST**

Micro Switch: Ralph C. Froehlich, manager of new Phoenix, Arizona office; R. J. Petersen, in charge of sales and engineering at Denver, Colorado.

Line Material Co.: C. J. Carter, fibre products sales engineer covering the Northwest and Alaska; office in Spokane, Washington.

Okonite Company: new offices and warehouse opened at 701 Phelps St., San Francisco, Calif.

Kuhlman Electric Co.: Walter H. Thompson, sales manager of the Western transformer division; offices in San Francisco.

Mitchell Manufacturing Co.: August H. Jaeger, Seattle, district manager for Washington and Oregon.

## WHERE TO BUY

# Advertising In This Issue



■

SEARCHLIGHT SECTION
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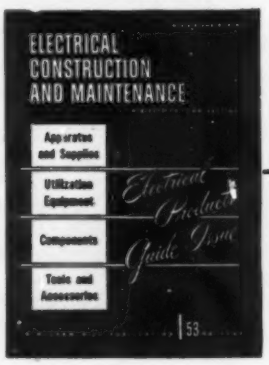


## • These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE

**For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.**

# NEW SIZE 1 REVERSING DRUM SWITCH

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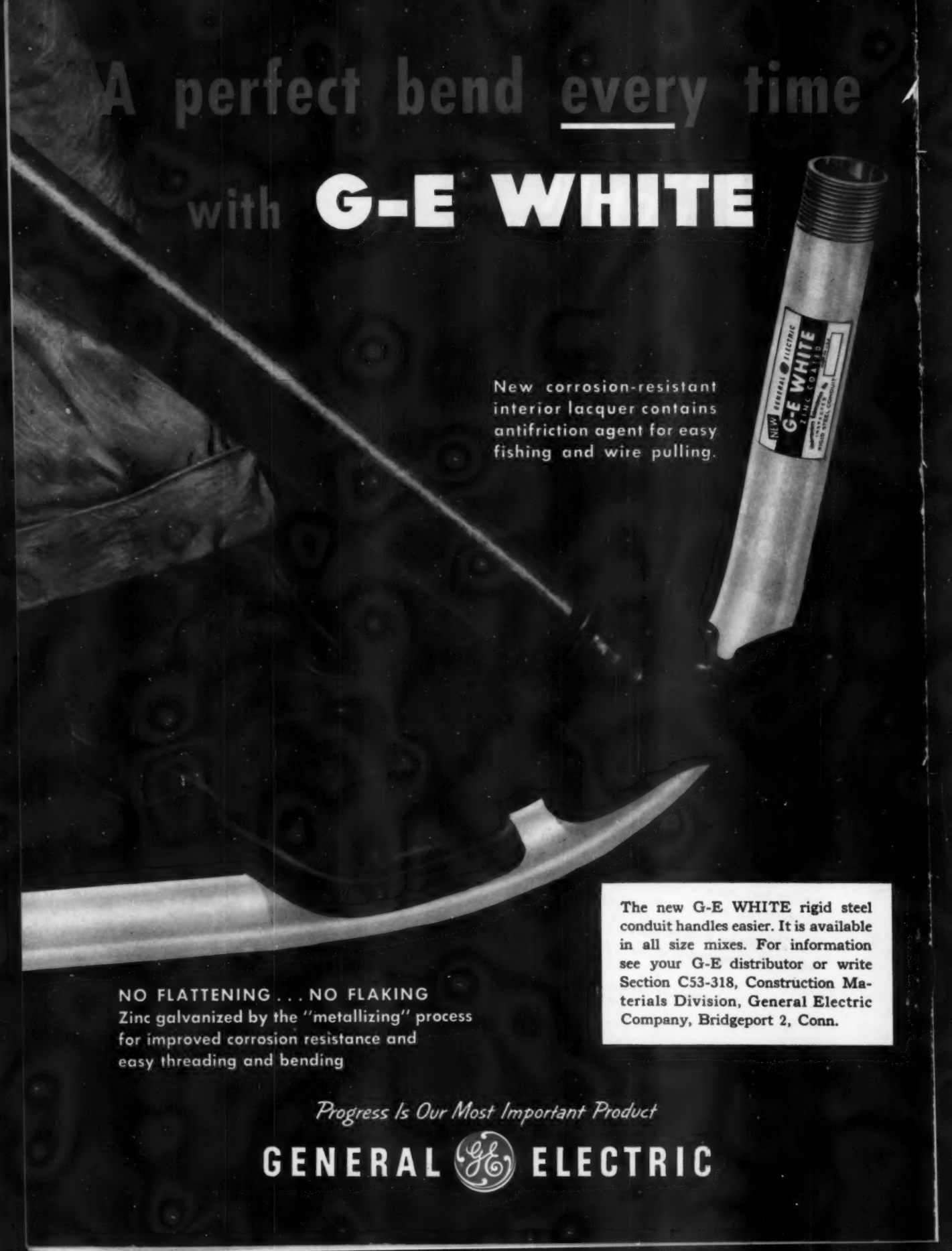
SQUARE D COMPANY

# A perfect bend every time with G-E WHITE

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NO FLATTENING . . . NO FLAKING
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